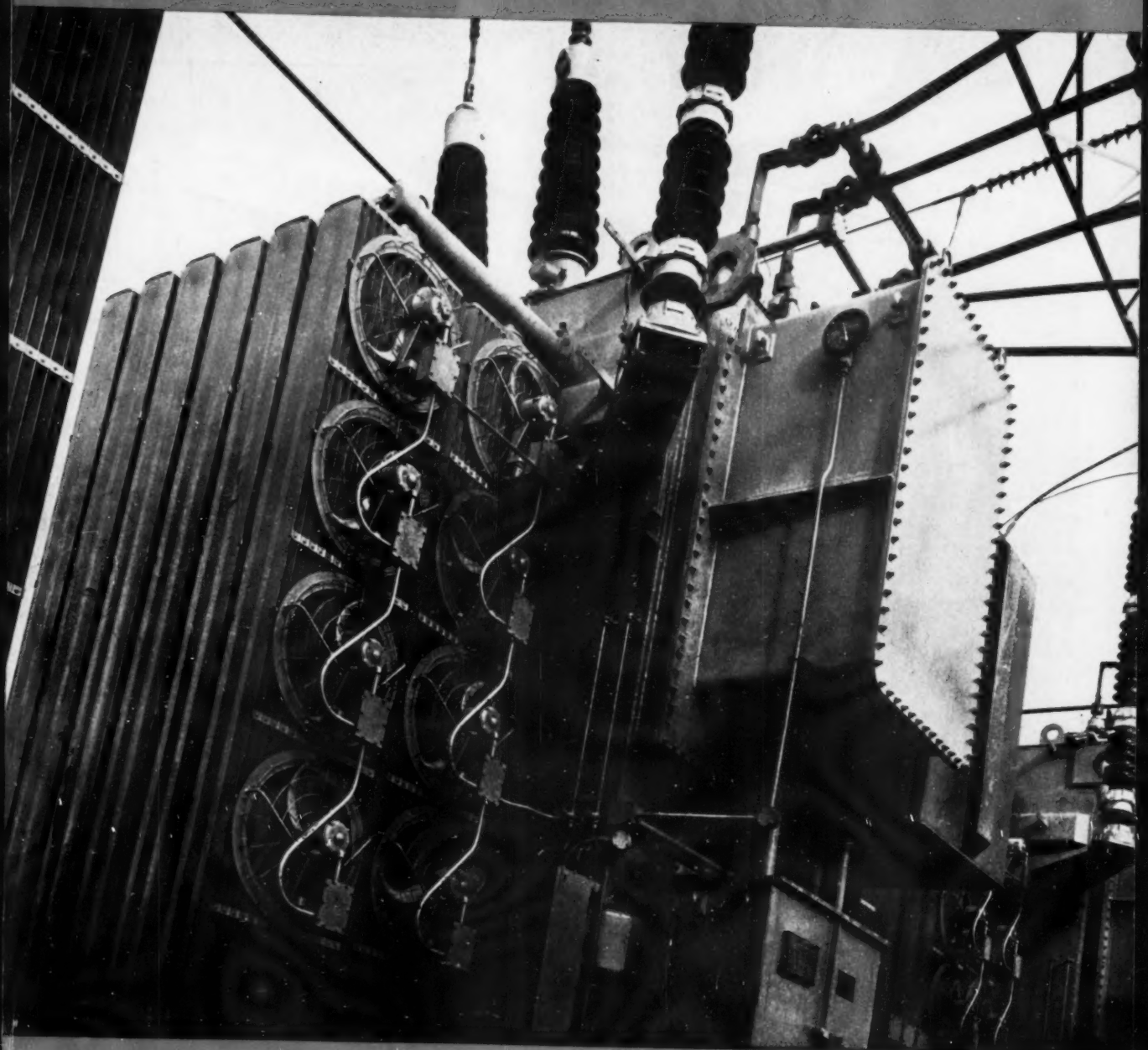
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

ATOMIC BATTERIES NOW? · 84
1100 F AT KEARNY · 100
REPAIR CASTINGS FAST · 111

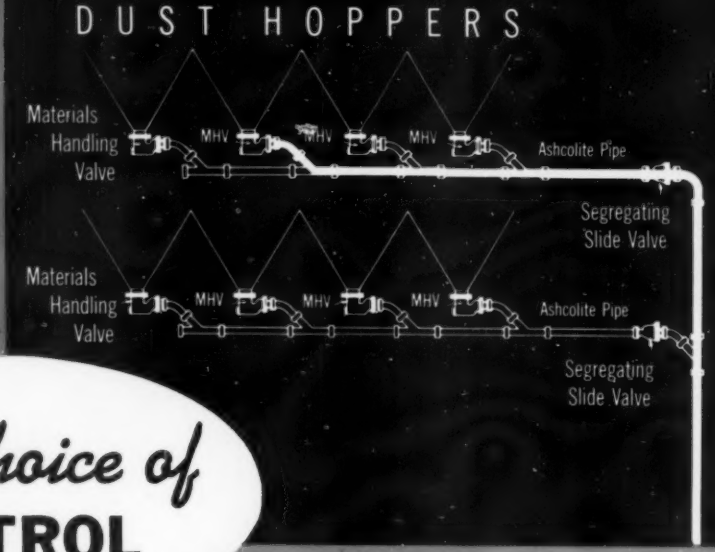
Power

April 1954·50¢
A McGRAW-HILL PUBLICATION



► How to cut your electrical power bill • p 75

DUST HANDLING



Your choice of CONTROL

MANUAL

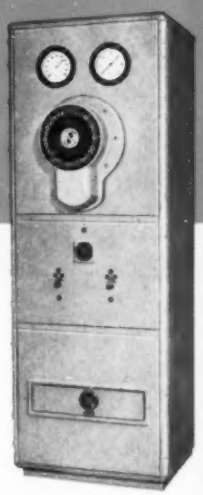
Up and down stairs to observe and operate the valves by hand.

REMOTE MANUAL

By keeping an eye on a vacuum gauge to know when a hopper has been emptied, one man at a central control panel can shift entrainment to another hopper.

AUTOMATIC

Turn a master switch and forget it! Being subject to vacuum changes, the A-S-H Automatic Sequence Head electrically closes the Materials Handling Valve as soon as its hopper is emptied, and immediately opens the next valve in the series—and, in proper turn, the Segregating Valves. This "brain" pays for itself by saving labor and minimizing abrasive wear.



The Automatic Sequence Head is completely wired, tested and ready for use when shipped.

Which control method is best for your plant? You have to weigh immediate against long-range costs and savings. Let the records of A-S-H installations and our experience help you.

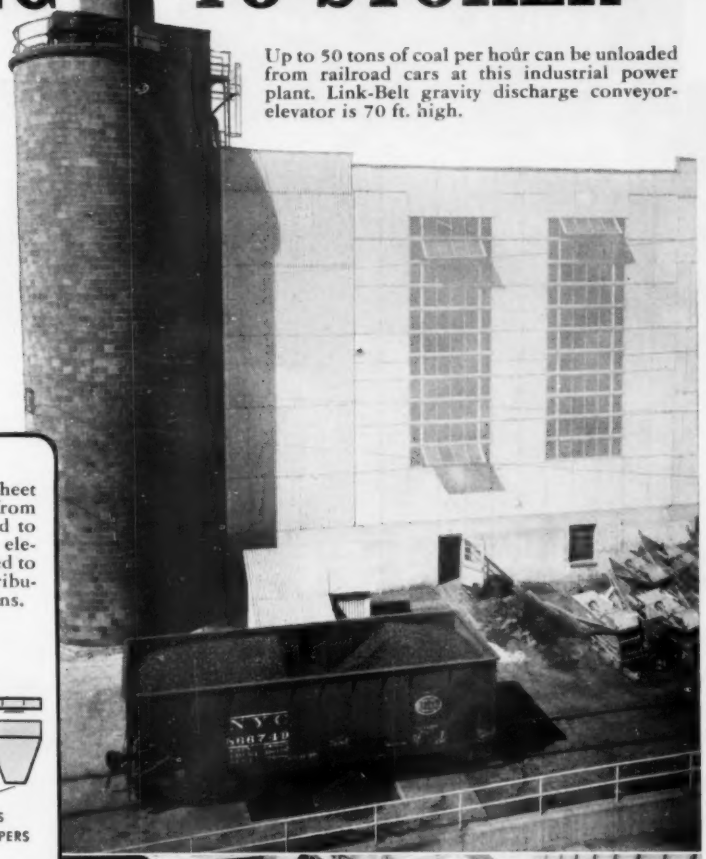
THE ALLEN-SHERMAN-HOFF CO. Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.
Offices and Representatives in Principal Cities

HYDROJET (hydraulic) HYDROVAC (pneumatic)

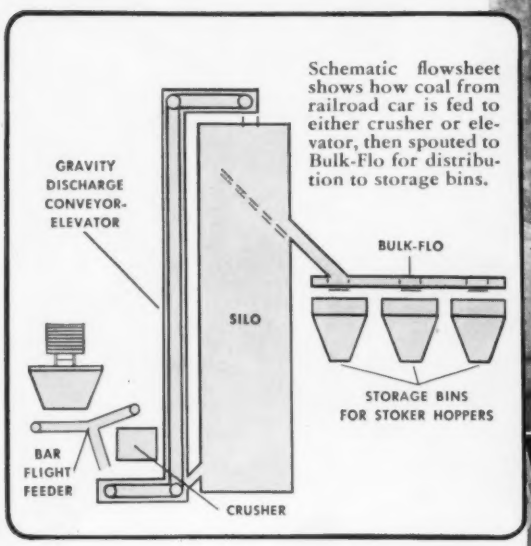
materials handling systems

FROM SIDING TO STOKER--

it's Link-Belt for low-cost coal handling



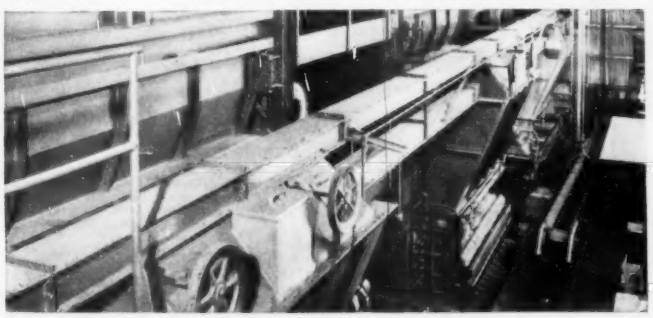
Up to 50 tons of coal per hour can be unloaded from railroad cars at this industrial power plant. Link-Belt gravity discharge conveyor-elevator is 70 ft. high.



Schematic flowsheet shows how coal from railroad car is fed to either crusher or elevator, then spouted to Bulk-Flo for distribution to storage bins.

Simple and effective, this Link-Belt bar flight feeder travels at 45 ft. per min., operates on 45-ft. centers.

WHETHER your coal handling requirements are large or small—Link-Belt can give you a system that assures top efficiency. A complete line of quality equipment is backed by unequalled engineering experience. And Link-Belt will carry through the entire job from planning to erection, if desired. See your Link-Belt representative for all the facts, or write for Book 2410 that shows the latest in modern power plant layouts.



Dust-tight Link-Belt Bulk-Flo feeder-conveyor delivers coal to any of three stoker storage bins at 15 tons per hour.

LINK-BELT

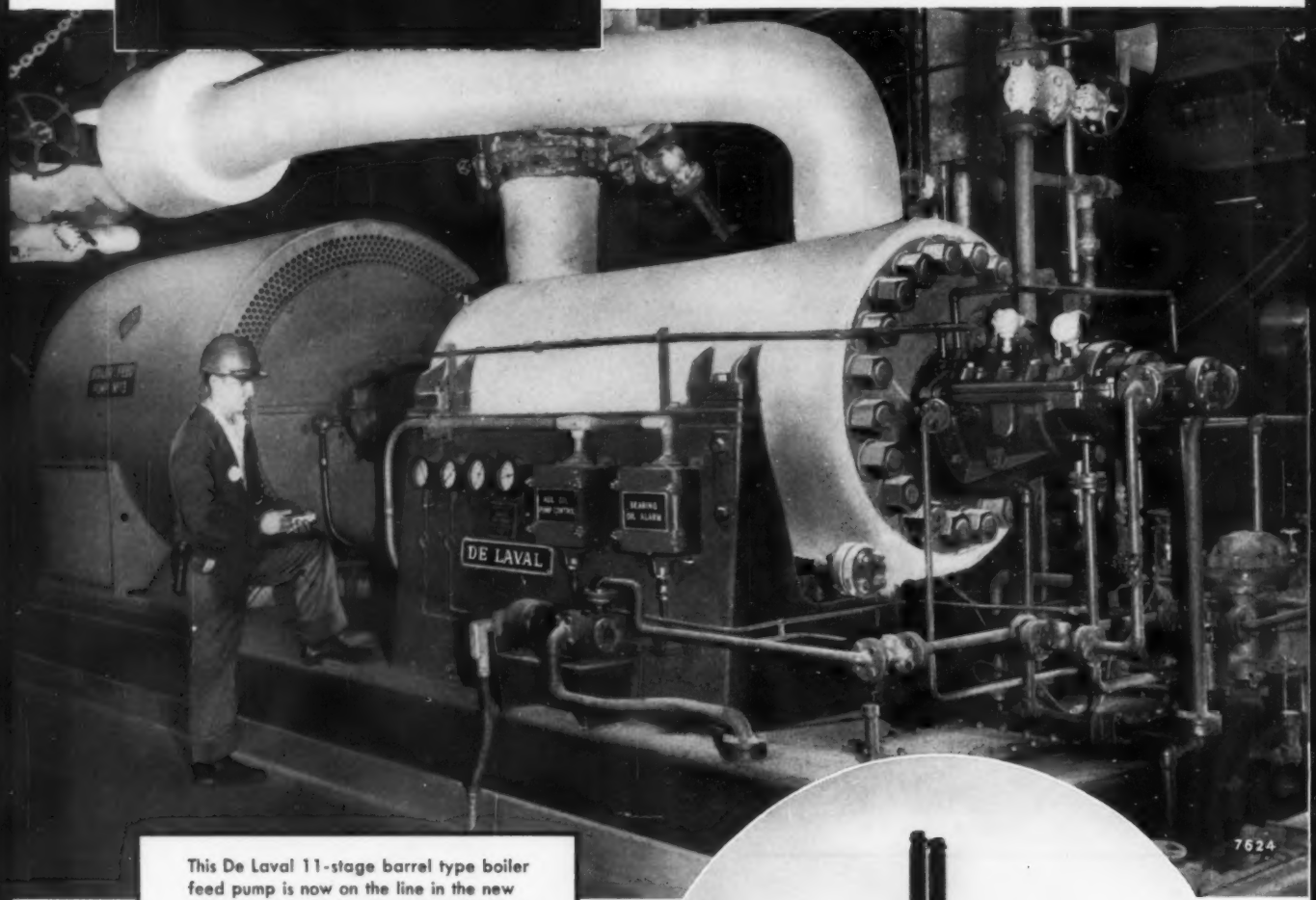
COAL HANDLING EQUIPMENT

13,405

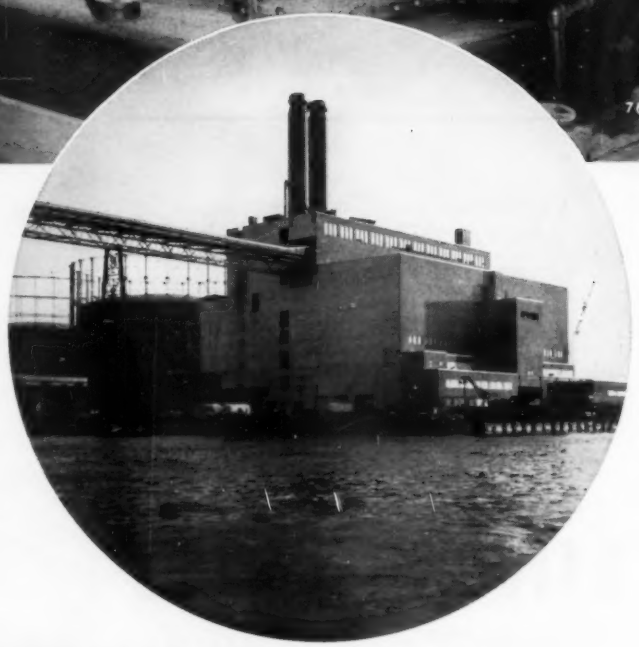
LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

DE LAVAL
BARREL TYPE BOILER FEED PUMP

in new Con Edison Astoria power station



This De Laval 11-stage barrel type boiler feed pump is now on the line in the new Astoria station of the Consolidated Edison Co. of New York.



The De Laval 8/6 pump operates at 129 psig suction pressure and delivers 1,570 gpm of 344 F water against 2,229 discharge pressure. Direct-connected at the end of the boiler feed pump shaft is a De Laval IMO pump for lubrication of the main pump and motor bearings. Also furnished is a motor-driven De Laval IMO auxiliary oil pump with pressure controlled switches. De Laval barrel type boiler feed pumps meet all the requirements of high pressure, high temperature boiler feed service. The distinctive De Laval design assures years of reliable operation with minimum maintenance.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL-287

Power

APRIL 1954 • VOLUME 98 NUMBER 4

ENGINEERING AND MANAGEMENT

Trim the cost of your electrical power 75
Part-load operation of superpressure feed pumps 80
Will atomic battery change methods of electrical generation? 84
Prevent accidents! Monthly program uses 3-point approach 86
Streamlined industrial power controls 90
The *Power* awards for modernization 94
Use high-temperature water now to step up efficiency and power 96
New reheat turbines at Kearny first to use 1100-F throttle steam 100
7000-hp atomic-powered locomotive 105
Data Sheet: Check water velocity to reduce maintenance 107

PLANT OPERATION AND MAINTENANCE

Today, you can save wrecked machinery 111
Hydrogen bomb in your plant? 114
New life for your old turbines 116
Get a *tight* safety valve 117
For better economy in small plants consider multiple feed pumps 118
Dual drives can save you dollars 120
Here's how to use the stroboscope 121
Three tips for speeding motor maintenance 122
Automatic auto gear for turning large rotors 123
Let's start your diesel engine and keep it rolling 124
Hot radiography process cuts pipe-weld inspection time 50% 126
How to install and maintain V-belt drives 128
Trouble-shooting an air-conditioning job 130
Practical ideas 132
Plant problems 138
Arguments 144
How-to 146
Headwork 148
Marmaduke Surfaceblow 150

READER SERVICE SECTION

Speaking of Power 154
Power news 156
Technical briefs 158
Plant equipment news 162
New free bulletins 171
George Edwards 174

Print ordr this issue: 47,365

APRIL 1954 POWER Vol. 98—No. 4

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▲ How to cut your electrical power bill - p 75

SUBSTATIONS are carving a key spot in the growing industrial electrical picture . . . and taking on a sleek look to boot. Today they're seldom built piecemeal. More often a complete factory-engineered unit is bought and slid into place, ready for connecting.

Our cover photo was prompted by this month's lead article, p 75—highlighting factors that trim electrical-power cost. The main sub comes into play dollar-wise on the metering angle. Lower charges go along with high-voltage primary metering, but ownership and maintenance of the sub are included in this package too.

Note the fans stacked on tubes of this oil-filled unit. They can give the transformer a triple rating: self-cooled, with one set of fans, with all fans operating. High-velocity fans can boost the top self-cooled rating of large liquid-filled units by 1.67 times the self-cooled rating.

Next month . . .

■ Dc machines are meeting growing need for faster speed and voltage changes. But as jobs become more exacting, maintenance and operating practices must spruce up. For a step in this direction, read how brush-potential measurements offer a practical method of making precise adjustments on dc machines.

■ Life expectancy of a cooling tower can better 20 years with sound water treatment, or drop to 5 with none. An upcoming article outlines just what is good treatment practice today.

■ Fully-outdoor Texas City industrial plant boasts all-welded boilers, plus a layout offering many operating advantages. Look for all details next month.

■ Con Edison is using telescopes for turbine-bearing lineup, rather than piano wire. Read how they get accurate results in but a fraction of the time.

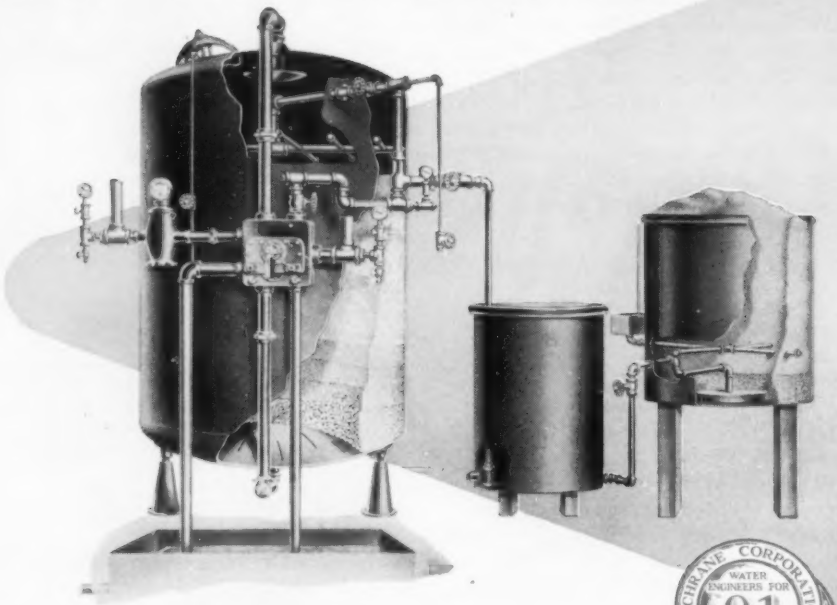
. . . and future months

■ *Heat Exchangers*, a 32-p special report in June, will contain latest data on the many heat-exchanger types available plus the fundamentals of heat transfer. Shell-and-tube units, evaporators, surface condensers are there, to mention but a few in a complete list.

HIGH EFFICIENCY

Cochrane ZEOLITE SOFTENERS

provide easy, economical operation



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The Cochrane Hydromatic Single Control Valve provides positive, accurate control of all phases of the softening and regenerating cycle.

It is so simple to operate that no technical knowledge of the softening process or the equipment is required. High quality effluent is thus assured at a minimum cost and maximum delivery.

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...lines and bylines

H C Bauman

INDUSTRIAL ELECTRICITY in all phases is home ground to H Carl Bauman, as readers of his past POWER articles know. This time (p 75), he tells how to buy power economically.

With Chemical Construction Corp and its parent company, American Cyanamid, Carl has designed electrical installations, supervised construction, operated power plants, developed new equipment and controls, shot trouble.

In his present post as asst head of CCC's Utilities Division, he's responsible for administration of air-conditioning, refrigeration, steam-power, fire-protection, waste-disposal, water-supply-and-treating sections. He also heads up power-rate, heat-balance and over-all power-generation studies.

Professionally, Carl's just about as busy. He's active in American Institute of Electrical Engineers, National Society of Professional Engineers, has chaired numerous committees and presented many technical papers. Leisure-time interests include electronics, photography, cabinet making, gardening, swimming and golf—"when time permits," as he modestly puts it. Somehow he also manages to take part in Cub Scout work and civic affairs in Jamaica, L. I.

C E Morrow

MODERNIZATION is something that C E Morrow takes seriously, as POWER readers who saw his August 1953 article (pp 71-75) will recall. Then he told, in graphic style, how a modernization program was worked out and "sold" to management. Now, beginning on p 90, he gives details on the control features of the new setup.

A University of Illinois graduate (BSME, 1924), Morrow began to build his power background at Ohio State, where he was asst prof of electrical engineering and asst supt of buildings. In 1937, he began his present connection with Western Electric Co. Then mechanical engineer, he later became service systems engineer and chief operating engineer of the Hawthorne power plant. Since 1949 he has been Engineer, Power and Service Facilities Engineering —Mechanical.

Coauthor R F Born graduated from University of Minnesota in 1947 (BME) and since has been mechanical engineer at Western Electric.

P L Geiringer

HEAT ENGINEERING, and particularly high-temperature-fluid heating systems, has been Paul Geiringer's prime interest since graduation from University of Vienna in 1918. An engineer and partner of the original Caliqua Co of Berlin, he opened that company's branch in Austria in 1928.

Coming here in 1940, Geiringer was a consulting engineer, did research at MIT, was associated with Jackson & Moreland and Submarine Signal Co of Boston. He's now president and chief engineer of American Hydrotherm Corp.

Floyd Hasselriis, coauthor of the article on p 96, holds degrees from Columbia (BSME, 1943) and University of Delaware (MSME, 1951). He began teaching at The Cooper Union in 1948. Consulting work with American Hydrotherm has now blossomed into a full-time engineering post.

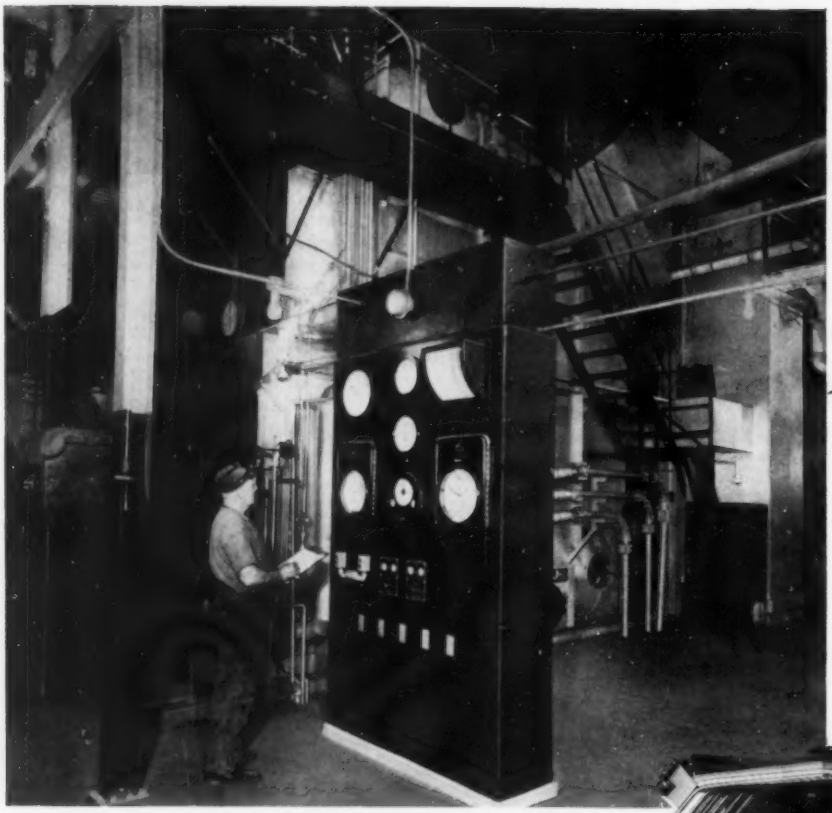
H J Vander Eb

OLD FRIEND Henry Vander Eb had his first POWER article published back in 1913, during Fred Low's editorship. His most recent one begins on p 111.

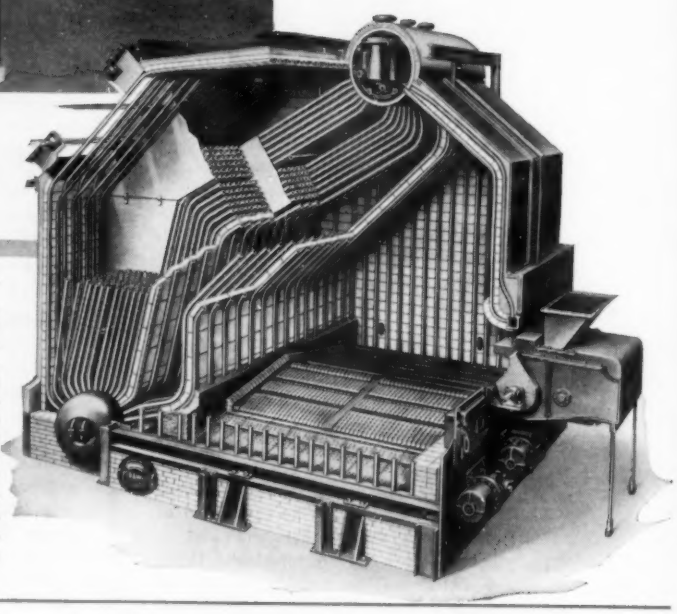
Born and trained as an engineer in Holland, Vander Eb gained wide practical experience in six years on transatlantic vessels before making a virtually lifelong connection with Hartford Steam Boiler Inspection and Insurance Co. In this 42-year career, the last 23 of which he was asst chief engineer, Vander Eb became an acknowledged expert on breakdown prevention and the making of reliable repairs. This fund of experience now serves him well in his consulting practice.

Henry makes a hobby of things mechanical. He invented the strain gage manufactured by L S Starrett Co. Its use for finding deflection of crankshafts is now routine in engine inspections.

VERIFIED FUEL SAVINGS



Boiler operator checks readings on control panel of company's new stoker-fired B&W Integral-Furnace Boiler, Type FF, which has performed so satisfactorily that fuel savings of more than 40 per cent have been estimated.



View of typical stoker-fired B&W Integral-Furnace Boiler, Type FF, similar to unit in service at Food Machinery & Chemical Corporation's Middleport, N. Y. plant. Suitable for stoker, gas, and oil firing, this B&W Unit is available in a steam capacity range of 8000 to 50,000 lb per hr at pressures to 600 psi. Complete design and operating details are described and illustrated in Bulletin G-71. Write The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

with a B&W Integral-Furnace Boiler

at

FOOD MACHINERY & CHEMICAL CORPORATION

"Good job—well done", is the comment of the Niagara Chemical Division of Food Machinery & Chemical Corporation, regarding the installation and continuing superior performance of a B&W stoker-fired boiler and air heater at this plant. Data on a weighed-coal metered-water test, run continuously for three days, showed that 128,180 lb of 13,105 Btu coal were required to produce 1,464,400 lb of steam. The operating conditions were—100 psi boiler pressure—feedwater at 225 F. The overall efficiency of this B&W Unit was calculated at 86.6% against a guaranteed 84% at 20,000 lb of steam per hr.

Plans for this installation at the Middleport, N. Y. plant followed central-station principles and were based on a complete survey, including operating data, made by the consulting engineer engaged by this nation-wide organization. At this point B&W engineers took over to handle complete erection . . . to place the boiler in operation . . . train operating personnel . . . and, finally, to turn over to the Niagara Chemical Division, a satisfactory, efficiently operating B&W unit that has since continued to live up to its reputation for reliable, economical service.

Service-Proved

COST SAVING FEATURES

of B&W Integral-Furnace Boilers for Steam Requirements from 2,800 to 350,000 Lb. Per Hr.

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX
BOILER DIVISION

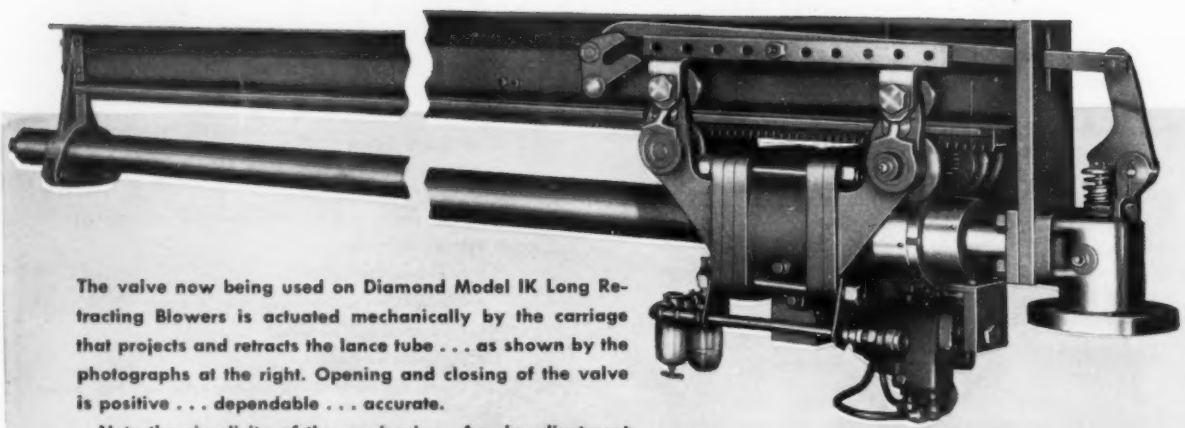
G-591

Mechanically Operated Valve

IMPROVES PERFORMANCE

OF DIAMOND MODEL IK

LONG RETRACTING SOOT BLOWER



The valve now being used on Diamond Model IK Long Retracting Blowers is actuated mechanically by the carriage that projects and retracts the lance tube . . . as shown by the photographs at the right. Opening and closing of the valve is positive . . . dependable . . . accurate.

Note the simplicity of the mechanism. Ample adjustment is provided to permit valve operation to be set at the proper point for each individual blower. This valve has very low pressure drop and is suitable for either steam or air blowing; it has the exclusive Diamond adjustable pressure control unit for selection of blowing pressure to meet individual blower needs. This mechanically operated valve was placed in field operation on numerous IK Blowers in severe central station service five years ago. Results were so satisfactory that it has been standard on IK Blowers for the last three years.

Air motor operated unit shown; also available electric motor operated.

For the many other advantages of the Diamond IK Blower, ask for Bulletin 1080.

DIAMOND POWER SPECIALTY CORP.
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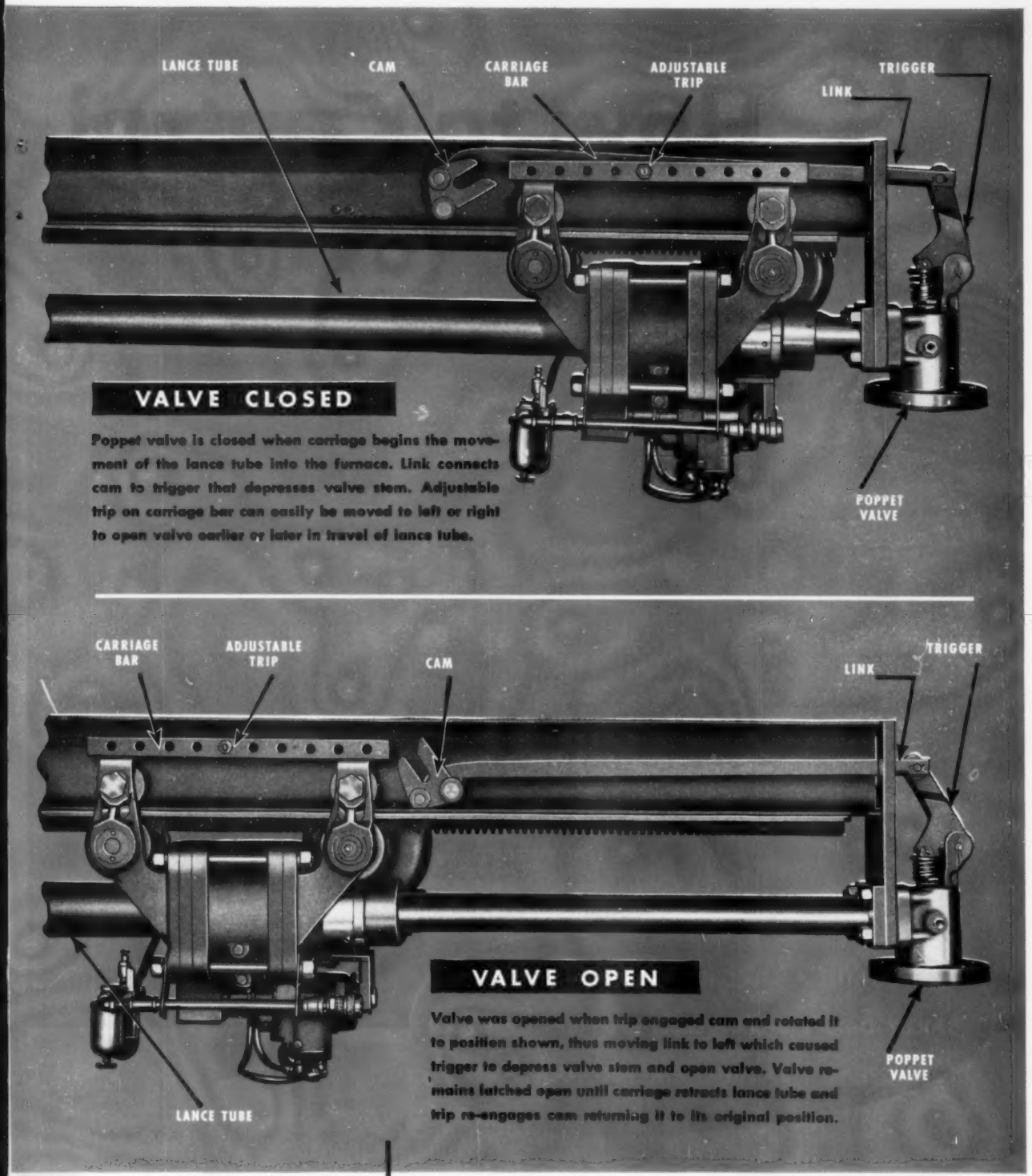
LANCE TUBE
CAM
CARRIAGE BAR
ADJUSTABLE TRIP
LINK
TRIGGER
POPPET VALVE
VALVE CLOSED
Poppet valve is closed when carriage begins the movement of the lance tube into the furnace. Link connects cam to trigger that depresses valve stem. Adjustable trip on carriage bar can easily be moved to left or right to open valve earlier or later in travel of lance tube.
CARRIAGE BAR
ADJUSTABLE TRIP
CAM
LINK
TRIGGER
POPPET VALVE
LANCE TUBE
VALVE OPEN
Valve was opened when trip engaged cam and rotated it to position shown, thus moving link to left which caused trigger to depress valve stem and open valve. Valve remains latched open until carriage retracts lance tube and trip re-engages cam returning it to its original position.

ADVANTAGES

- *Positive valve action*
- *Simple and rugged mechanical linkage*
- *Adjustable valve operating position*
- *No critical adjustment for tight valve seating*
- *Completely adaptable to steam and air blowing, interchangeably*
- *Low pressure drop*
- *Adjustable pressure control on each individual blower*

How to Control

FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

Control Center for 125,000 KW reheat boiler-turbine Unit No. 1 at Meramec Station, Union Electic Co. of Missouri. Bailey MINI-LINE Equipment on benchboard gives operators fingertip control while larger recorders on vertical board show operating trends and make permanent records.

Steam Cost

★ Close regulation of fuel and air input is vital to a strict control of your steam cost. But that's not all. You'll need control of other factors, too. Your power costs can be held down only by controlling all of the important operations in your steam plant. That's where you can be sure of help from Bailey Controls. Here's why they can do the job and do it right:

1. Complete Range of Equipment—fully co-ordinated

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, as might be the case if he had only a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. Engineering Service—backed by experience

No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement, and automatic control.

3. Direct Sales-Service—conveniently located near you

Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

For close control of steam cost, more power per fuel dollar, less outage, and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More Power To You!"

A-120-2

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Complete Controls for Steam Plants

BAILEY METERS
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FEED WATER
TEMPERATURE
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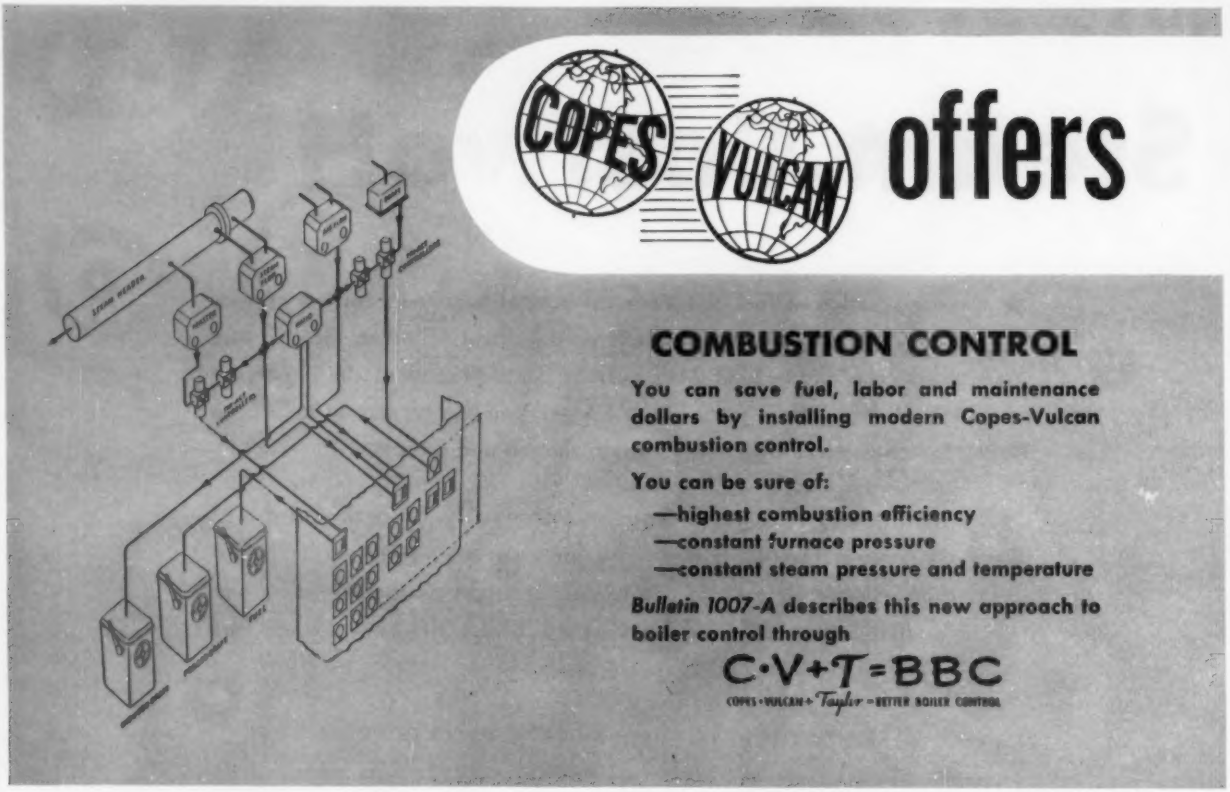
FEED PUMPS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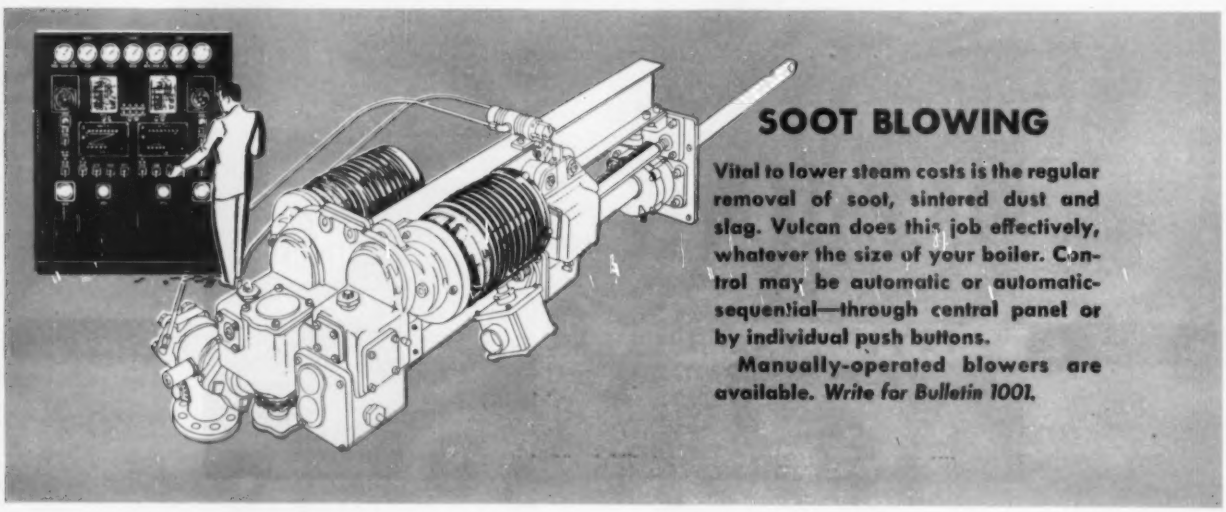
offers
COMBUSTION CONTROL
You can save fuel, labor and maintenance dollars by installing modern Copes-Vulcan combustion control.
You can be sure of:
—highest combustion efficiency
—constant furnace pressure
—constant steam pressure and temperature
Bulletin 1007-A describes this new approach to boiler control through
C·V+T=BBC
COPES·VULCAN+Taylor=BETTER BOILER CONTROL

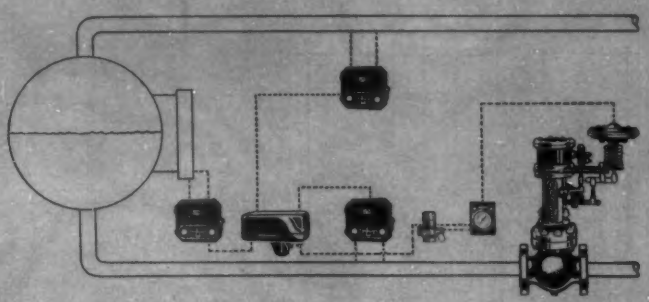
Reduce your steam costs. Get more efficient and safer boiler operation. Use one or more of these four Copes-Vulcan aids to offset rising costs of fuel, labor and maintenance. C • V + T offers a new approach to boiler control—with undivided responsibility from analysis to installation—and service wherever needed for the life of the installation.


SOOT BLOWING
Vital to lower steam costs is the regular removal of soot, sintered dust and slag. Vulcan does this job effectively, whatever the size of your boiler. Control may be automatic or automatic-sequential—through central panel or by individual push buttons.
Manually-operated blowers are available. Write for Bulletin 1001.

4 aids to lower steam costs

FEED WATER CONTROL

Copes feeds exactly as needed to maintain correct water level while meeting steam demands. Three-, two- or one-influence systems are available for your specific needs. Control may be independent, or tied in with combustion control. Take a look at the newest three-influence COPES instrument-type feed water control system—Type 3-L, described in *Bulletin 1013.*

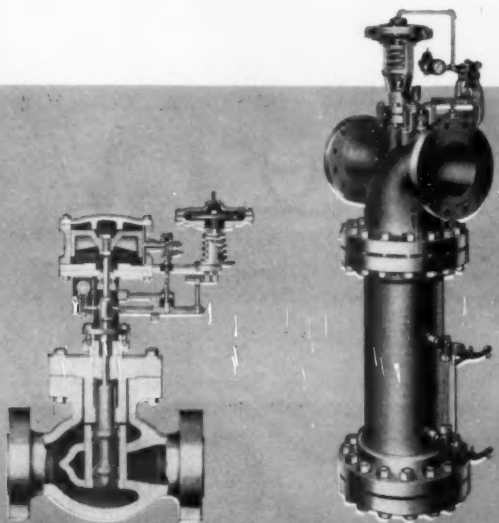


COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

REDUCING and DESUPERHEATING

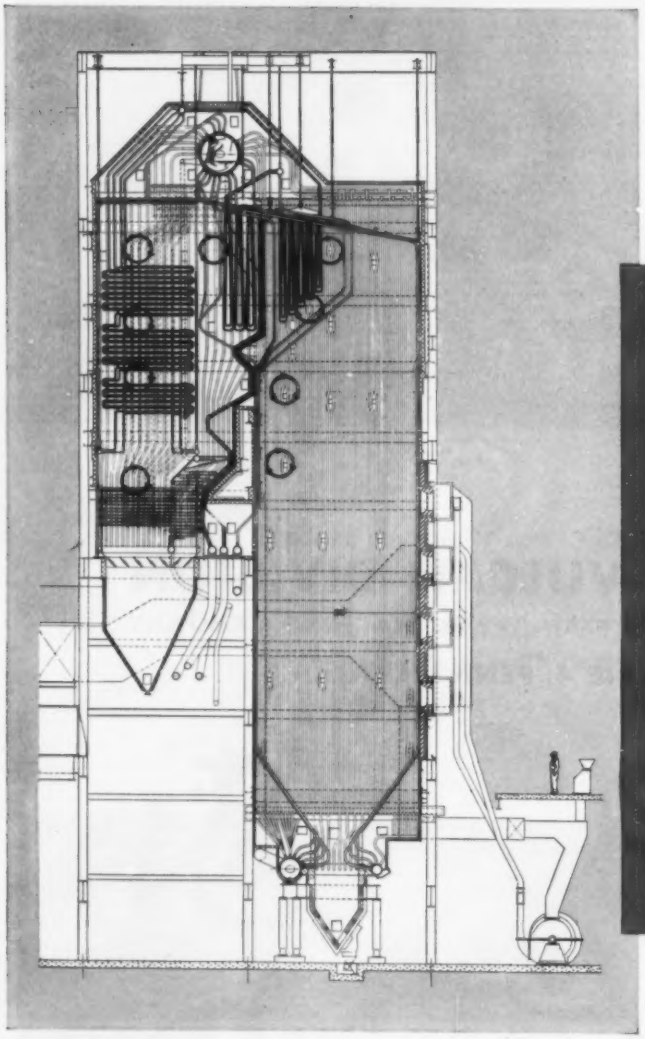
Copes Reducing Valves have ports characterized for specified flow and pressure conditions. Rugged construction throughout. *Write for Bulletin 477-A.*

Copes Desuperheaters are self-contained, need no "extras" for installation. Temperature control is accurate, even on lightest flows, because cooling water is fully controlled inside the chamber. *Bulletin 405-C.*



VULCAN SELECTED FOR UTAH POWER &

AUTOMATIC
Unit 2 is all



BOILER DETAILS

Reheat Steam Generator, Riley Stoker Corp

Maximum Capacity....575,000 lb per hr

Superheater Outlet Pressure...1525 psig

Primary Steam Temperature.....1000 F

Reheat Steam Temperature.....1000 F

Fired with Petroleum pitch and Pulverized coal

Soot Blowing. Vulcan Automatic-Sequential System with electric-driven long retractables blowing with steam, controls for air-heater cleaners

Consulting Engineers..Bechtel Corporation

VULCAN *Automatic*

REHEAT STEAM GENERATOR AT
LIGHT COMPANY, GADSBY PLANT

SEQUENTIAL SYSTEM *for* electric . . . all outdoors

Electric-driven Vulcan long-retractable soot blowers, with electric automatic sequential control of the cleaning operations, have been selected for Unit 2 at Gadsby Plant.

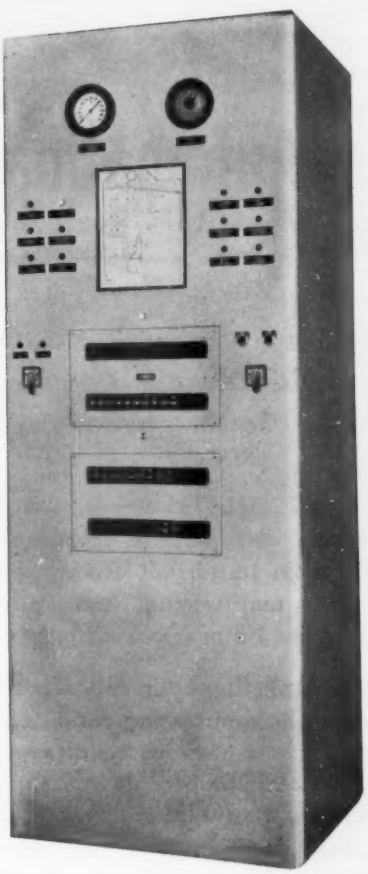
Electric drive may seem to cost more than air, but it needs no added compressor capacity. Cleaner and quicker, it operates more smoothly and at lower cost. It has a more dependable power supply. And in outdoor installations, it has no control-air lines to freeze in winter weather.

Vulcan long retracts effectively clean the most inaccessible areas, even with travels over 25 feet.

And Vulcan Automatic-Sequential Control makes cleaning a simple matter of pushing a button at a central panel. There is no need to patrol the boiler, for the entire operation is reported visually.

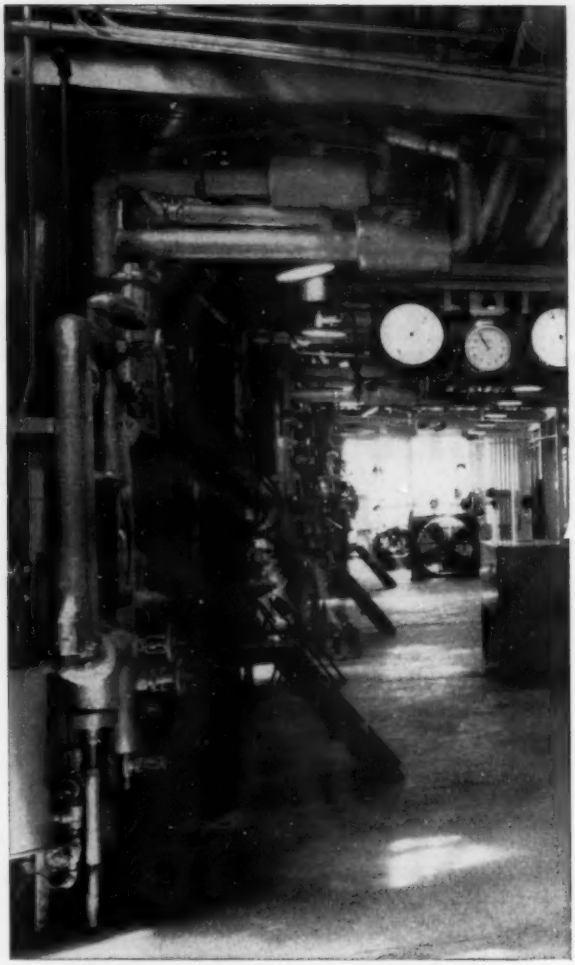
Large or small, utility or industrial, power or process—your boilers can be cleaned better and at lower overall cost by Vulcan Automatics.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA



Operation of each blower is reported back to this central panel, where the operator merely flicks his wrist to start the automatic or selective sequence, or to work a single blower manually.

Controlling Costs Automatically



Republic Automatic Combustion Controls Offer All Types of Boiler Plants Three Ways to Save

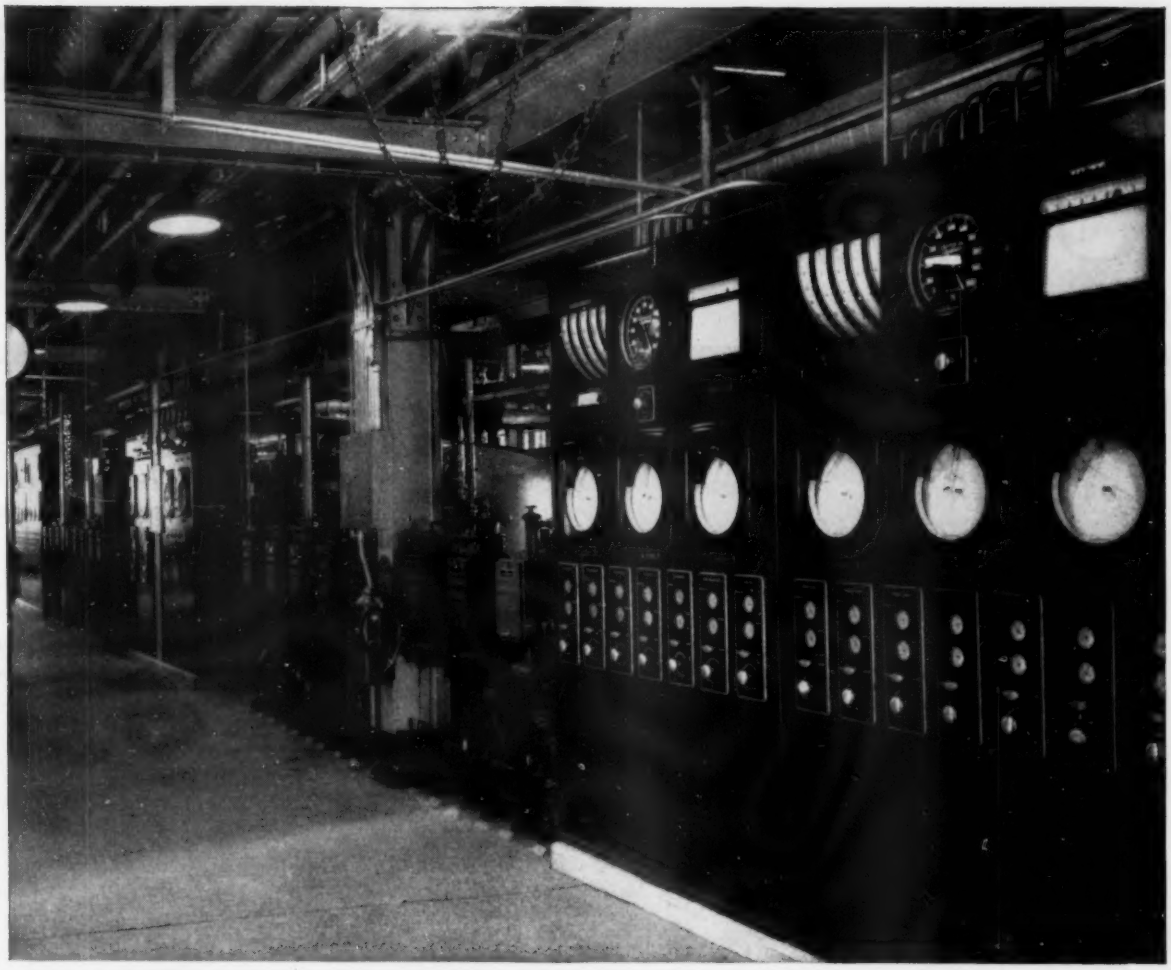
AUTOMATIC combustion controls are looked upon primarily as fuel savers. That's their most important advantage, but their effect on maintenance and equipment costs should not be overlooked, either.

For example, Republic Automatic Combustion Controls hold operating conditions uniform to prevent chain-of-event troubles and high maintenance costs that result from incorrect boiler operation. Republic controls, themselves, are ruggedly built to give years of dependable service.

Also consider the cost of stand-by equipment that must be purchased because boilers can't be continuously operated manually to produce the maximum steam output they are capable of generating. Human efficiency just isn't that good. Boilers operated by Republic Automatic Combustion Controls, however, perform at maximum efficiency, 24 hours a day, 7 days a week . . . at all loads. Expensive excess boiler capacity is not necessary to meet "peak" loads.

Republic Automatic Combustion Controls are used in all sizes and types of boilers, in central stations and in small industrial steam plants. Whatever the size or type of your boiler, the type of fuel burned or the load conditions, we can help you control costs by automatically controlling combustion. Write for complete details or contact your nearby Republic field engineer.

REPUBLIC FLOW METERS CO.



Republic Automatic Combustion Controls

At Carter Oil Company • Billings, Montana

The boiler plant for Carter Oil Company's modern refinery at Billings, Montana is operated for maximum efficiency by a complete Republic control system for combustion, feed-water and desuperheating. Automatic combustion controls are coordinated with feedwater and desuperheater controls to enable the boilers to meet all load changes smoothly.

The plant consists of four boilers, each rated at 42,000 pounds of steam per hour. Total steaming rates average 125,000 pounds per hour. The boilers are gas fired with oil as standby. Both fuels may be fired simultaneously, if desired.

Looking down the firing aisle of the Billings refinery in the photograph above, Republic control panels for the boilers are at right. Located at the left of each panel are Republic regulators which send control impulses to positioners of fuel valves and fans. Feedwater regulators are also located with the combustion regulators.

2240 Diversey Pkwy., Chicago 47, Illinois

Important SUPERCHARGED

Here's what operation-proved A-C development can do for you now, and in the near future

BY CUTTING GENERATOR SIZE, *supercharged* cooling permits you to reduce plant size, lower foundation and crane costs, and use smaller breakers and bus structures. Mechanical design limitations are minimized, while possible maximum ratings are raised, and field assembly problems are simplified.

Two of the *supercharged* units now in operation are shown in the accompanying photographs. The installed units and others in various stages of production utilize direct rotor conductor cooling with high-velocity hydrogen to increase the generator rating more than 70% over conventional hydrogen cooling. Backed by experience gained from the first *supercharged* units, Allis-Chalmers is now building a *completely supercharged* generator resulting in the remarkable size reduction shown on the facing page.

For basic design information and a more detailed explanation of the many advantages of this outstanding engineering development, ask your A-C representative for the latest literature on *supercharged* cooling. Or, write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-4251

Installed at Wisconsin Power and Light Company's Edgewater Station in 1951, this 60,000-kw turbine-generator unit has proved the soundness of Allis-Chalmers pioneering engineering. Its excellent performance during the first two calendar years of commercial operation *(1952 and 1953)* can be summarized as follows:

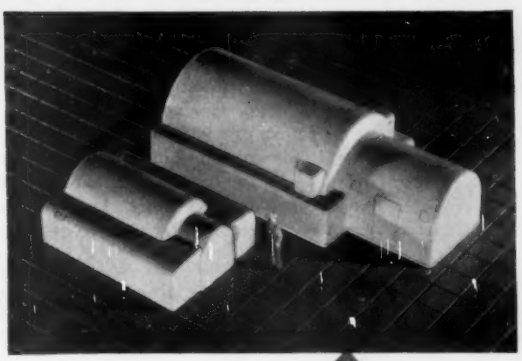
Hours in service	17,199
Service factor	98.03%
Chargeable outages	one
Availability factor	99.86%
Total generation	885,951,000 kw-hrs

Another unit, with a *supercharged* generator but incorporating new Allis-Chalmers steam turbine design features, was placed in operation early this year at Wisconsin Power and Light Company's Rock River Station.

ALLIS-

Facts About Cooling

ANOTHER *supercharged* unit — at the Dixon Station of Commonwealth Edison Company's Public Service Company Division. On the line since late summer of 1953, this 60,000-kw turbine-generator unit was placed in commercial service a few days after the initial start.



GREAT difference in size of *fully supercharged* and standard hydrogen-cooled generators of same kw rating suggests the increased advantages full supercharging offers in power plant space, crane capacity, quantity of gas, cooling water requirements, differential expansion, shipping clearances, and many other first-cost and operating factors.

CHALMERS

A-C ALLIS-CHALMERS

Which C-E Boiler meets YOUR steam needs best?

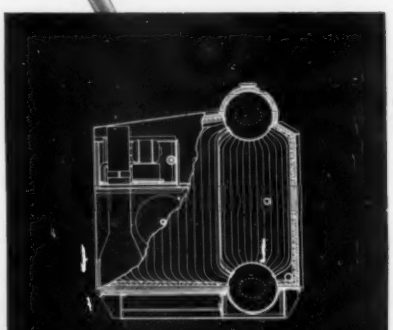
These four C-E Boilers have been specifically designed to meet the requirements of a wide variety of plants. Collectively, they offer you a range of capacities from 4,000 to 350,000 pounds of steam per hour... pressures up to 1375 psi... temperatures to 960 F... arrangements for any fuel or method of firing.

Two of these units, the VP and the VU-10, are fully standardized. Each of the other two has been standardized as far as is practical for its particular field of application. Thus, all four units reflect in purchase price minimum engineering costs made possible by maximum design standardization.

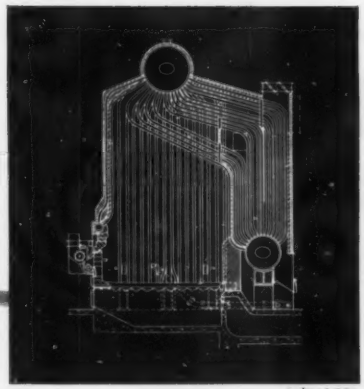
It's small wonder, then, that industries of all kinds have demonstrated widespread acceptance of C-E Industrial Boilers. The low steam costs and top reliability of these Combustion Boilers can be your guide, too, to the maximum return on your new boiler investment.

B-703

C-E Package Boiler — Type VP The VP Boiler is designed to meet the demand for compact, standardized units in the medium pressure range. It is shipped completely shop-assembled, with firing equipment, fittings, and forced-draft fan. It is enclosed in a reinforced, welded steel, gas-tight casing. Arranged for pressure firing of oil or gas, the VP will burn either fuel exclusively or alternately. Designed for shipment by rail or truck, its width and height remain constant... variations are made in length only. Furnace is fully water-cooled, including burner wall, except in three smallest sizes. Large lower drum permits simple, symmetrical tube arrangement and greater water storage capacity.

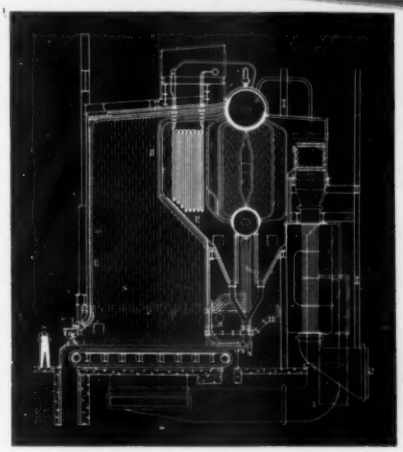


Type VP Boiler — from 4,000 to 30,000 lb steam per hr . . . pressure to 250 psi . . . available for either gas or oil firing . . . fully shop-assembled.



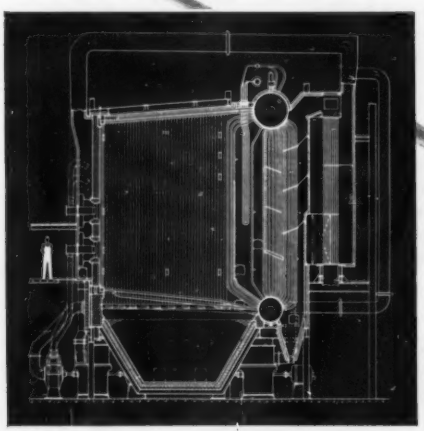
C-E Vertical-Unit Boiler — Type VU-10 Like the Type VP Package Boiler, the VU-10 is designed for plants having a limited number of operating and maintenance personnel. It is designed for industrial load conditions and will operate efficiently over a wide range of output. The boiler is bottom supported and has no outside supporting steel. The same general cross-section arrangement of drums, boiler convection bank, and furnace wall cooling is used when firing oil, gas or coal. Coal firing may be with underfeed, spreader, or chain grate stokers.

Type VU-10 Boiler — From 10,000 to 60,000 lb steam per hr . . . pressure to 475 psi . . . superheat to 200 F . . suitable for any type of fuel.



C-E Vertical-Unit Boiler — Type VU-40 The VU-40 Boiler is a baffleless boiler designed for use with fuels having abrasive qualities in the flue dust. In a baffled boiler using these abrasive fuels, erosion is apt to occur. In the VU-40 Type Boiler, the eroding action of abrasives against boiler tubes and refractory is virtually eliminated. Like the VU-10 and VU-50, this unit is of symmetrical design, providing uniform gas flow and heat absorption across the full width of the boiler.

Type VU-40 Boiler — from 60,000 lb steam per hr up . . . pressure to 1375 psi . . . temperature to 960 F . . . for use with abrasive or high ash content fuel . . . indoor or outdoor type construction.



C-E Vertical-Unit Boiler — Type VU-50 With the VU-50 Boiler, the average plant can achieve standards of performance closely approaching those of large central power stations. The basic design was originated by Combustion in 1925 and has been widely accepted among steam-power engineers everywhere. Because of its symmetrical design the VU-50 provides uniformity of gas flow, water level and steam release across the full width of the unit. It may be fired by pulverized coal as shown opposite or by any other fuel or method of firing. Heat recovery equipment may be added.

Type VU-50 Boiler — from 60,000 to 350,000 lb steam per hr . . . pressure to 1375 psi . . . temperature to 960 F . . . for any fuel or method of firing . . . indoor or outdoor type construction.

COMBUSTION ENGINEERING, INC.

Combustion Engineering Building • 200 Madison Ave., New York 16, N. Y.

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

...invisible values

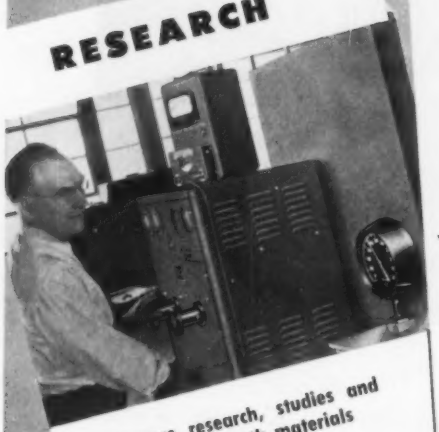
Separate an Ashcroft Gauge into its component parts and many of the reasons that have made it the leader for over a century remain unseen. For they are invisible values . . . equally as important to the sustained high accuracy and long-life endurance of the gauge as the Bourdon Tube, the movement, linkage, case and other components.

Creative research, highly functional design, quality control of both materials and methods and rigid manufacturing standards are "built into" every Ashcroft Gauge . . . are the fundamental reasons why high performance standards are expected and attained in every gauge bearing the Ashcroft Shield.

The new Ashcroft Gauge Catalog 300 is now available. Write for a copy.

YOUR INDUSTRIAL SUPPLY DISTRIBUTOR is thoroughly acquainted with the various lines of Ashcroft Gauges. You can depend on him to help you in selecting the right type for your particular needs—and to deliver promptly.

RESEARCH



Continuous research, studies and tests guarantee both materials and methods.

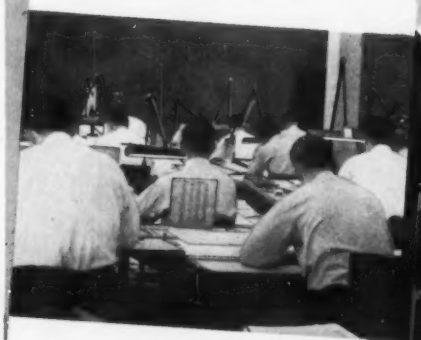
Completed designs as well as individual components are subjected to "breakdown" tests in the Research Laboratory pictured here. These tests subject all materials and methods to vigorous analyses . . . are designed to keep Ashcroft ahead of future as well as current gauge requirements regardless of industry demands.

ASHCROFT GAUGES

of ASHCROFT GAUGES

1850 ASHCROFT U.S.A.

DESIGN



Sustained accuracy is the major objective of the design function.

Where research largely determines materials and methods to be used, the design function is primarily concerned with sustained high accuracy. The drafting room shown above is one of the most essential "creative centers" in the progress of an Ashcroft Gauge from original research to finished product.

QUALITY CONTROL

Ashcroft metallurgists subject all raw materials and parts to thorough examination and tests.

Augmenting research and design, quality control exhaustively examines, for functional surety, all materials used in the gauge as well as the finished product. No substitute for final inspection, quality control "guards the gauge" from original design to final manufacture.

MANUFACTURING

Highly skilled craftsmen command the most modern equipment and plant facilities to assure manufacturing excellence.

This unbeatable combination produces the Ashcroft Gauge . . . an achievement in metal . . . first conceived by Ashcroft research and design engineers and completed by unmatched production techniques. Pictured is one of the assembly sections where perfection of gauge performance is considered a manufacturing challenge as well as a responsibility.

1850 ASHCROFT U.S.A.

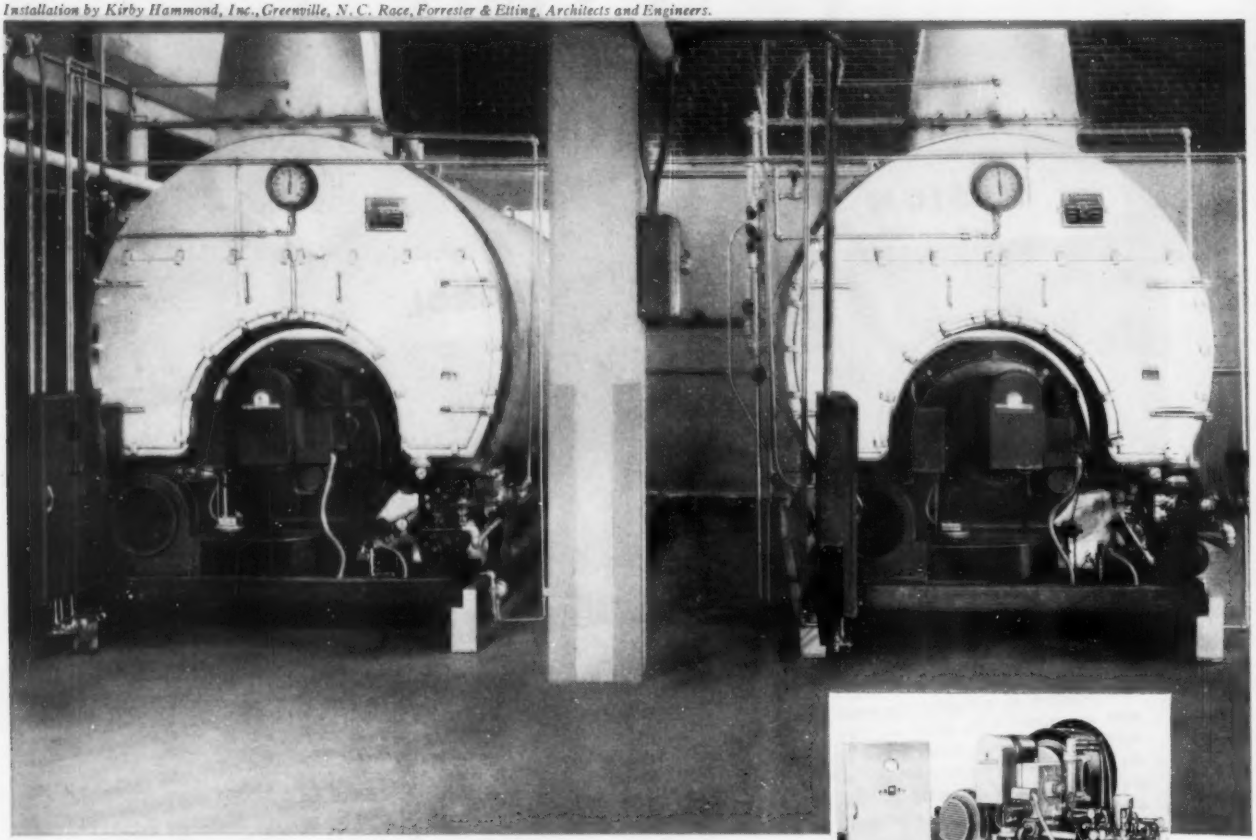
A PRODUCT OF **MANNING, MAXWELL & MOORE, INC.**

STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

"Packaged" for better firing at lower cost

Installation by Kirby Hammond, Inc., Greenville, N. C. Race, Forrester & Etting, Architects and Engineers.



Iron Fireman packaged industrial oil burners integrated with Scotch marine type boilers in the plant of Belrug Mills, Inc., Greenville, South Carolina. At right, Iron Fireman oil-gas packaged unit. With this unit it is possible to switch fuels at any time, at a moment's notice.

Engineered as a single complete unit

This Iron Fireman package unit is much more than a conversion burner. It's a complete combustion system in which all elements are correctly balanced and integrated—a thoroughly engineered firing plant. It includes burner (for oil or gas or both), fuel system, forced draft air supply, control panel, and pre-formed refractory combustion throat. Installation requires little more than bolting the entire unit to the boiler front and making service connections for power and fuel.

To the user this means an attractive saving in installation time and cost. But even more important, it means a factory assembled and tested unit instead of a locally assembled job. It means dependable performance and high operating efficiency, with substantial fuel savings. It's the *smart* way to modernize your boiler room.

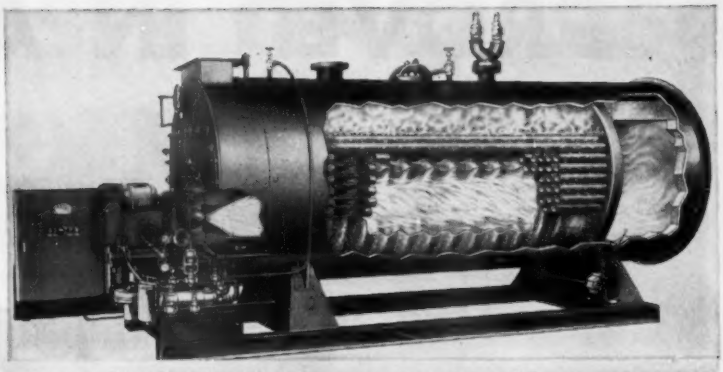
Get in touch with your Iron Fireman dealer, or mail the coupon on the opposite page for complete information.

THE IRON FIREMAN

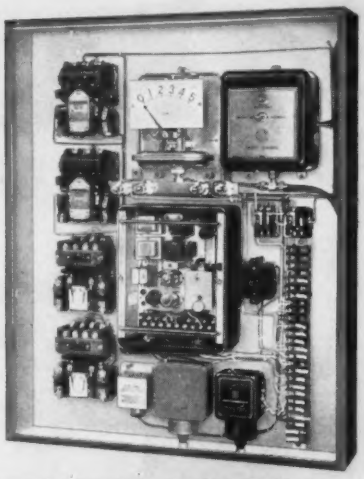
Iron

OIL, GAS AND COAL FIRING

OIL, GAS or OIL-GAS COMBINATION BURNER UNIT BY IRON FIREMAN



Cutaway view of packaged boiler-burner unit consisting of Scotch marine boiler with Iron Fireman combination Gas-Oil forced draft burner. The shift from one fuel to another is accomplished quickly, with no sacrifice in firing efficiency.



WIRED, TESTED CONTROL PANEL

Control panel is totally enclosed, with all instruments wired and tested at the factory. Entire wiring system is coded, with varicolored wires and numbered terminal strip inside panel. An indicating meter on the panel door shows the condition of the control system at all times. Indicating lights on panel front show operating status of unit at a glance. Green lights show motors in service; red indicates safety lockout.

IRON FIREMAN ROTARY OIL BURNER

The oil firing unit is the Iron Fireman rotary cup oil burner which has an outstanding record of reliability in precision firing of hard-to-handle heavy oils. Heart of the oil control system is the Iron Fireman Oil Volumeter, a variable volume metering pump submerged in the oil reservoir, which delivers the correct volume of oil to the burner head with extreme accuracy, regardless of changes in oil viscosity. Burns any grade of oil, from lightest to heaviest, without special adjustment.

REFRACTORY COMBUSTION THROAT

The combustion throat, with preformed built-in refractory, is an integral part of the burner unit. Both primary and secondary air are admitted to the combustion chamber through this throat, eliminating the special brickwork required by the usual conversion burner and greatly improving the air-fuel mixture. Oil cup is in the center of the refractory disc, which also shields the gas jets against the radiant heat of the furnace. Adjustable inlet vanes control the shape and rotation of the flame to match the requirements of the firebox or firetube.

No divided responsibility

No separate contracts for (1) boiler setting (2) electrical wiring (3) oil heating equipment (4) automatic control system (5) forced draft system (6) boiler refractory.

You can install a complete new boiler plant quickly and economically by specifying an Iron Fireman packaged burner and a Scotch marine type boiler engineered specifically for use with this unit. Forced draft, no high stack required. Or you can install the Iron Fireman packaged burner in practically any type of existing boiler, with important savings in installation and operating costs.

How to specify

First, decide what fuel or fuels you want to use (oil, gas or oil-gas combination). Second, determine the load. Third, refer to table in Iron Fireman catalog or specifications for the correct size of burner and boiler for your job.

For more information use the coupon below.

Fireman

FOR HEATING, PROCESSING, POWER

Iron Fireman Mfg. Co., 3044 West 106th Street, Cleveland 11, Ohio. In Canada, write 80 Ward Street, Toronto, Ontario.

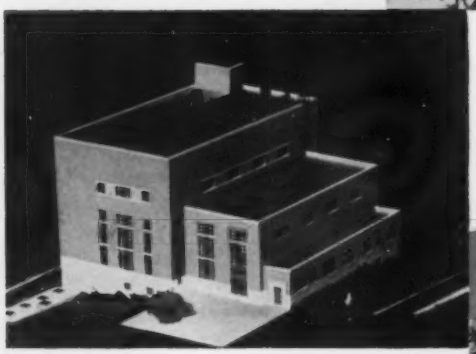
Please send me literature giving full information on the Iron Fireman "packaged burner" unit.

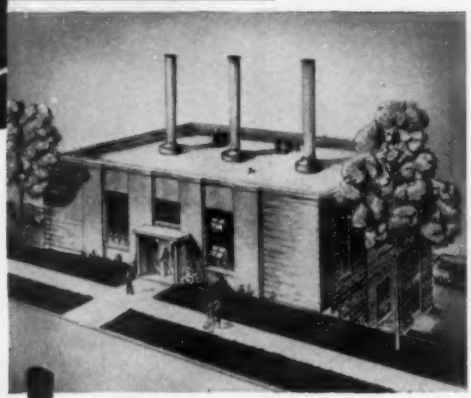
Name _____

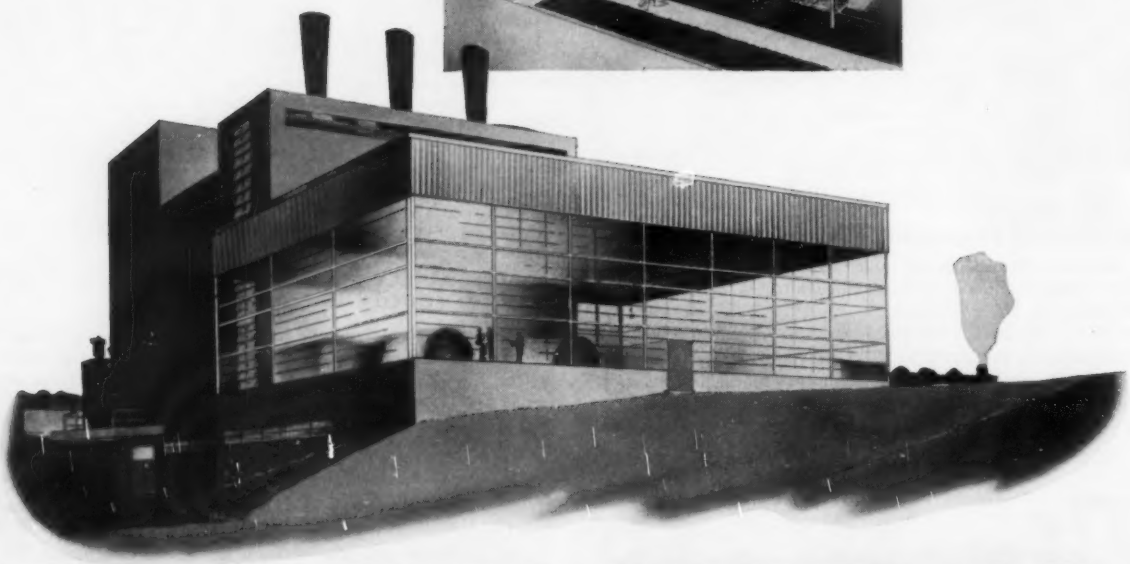
Address _____

City _____ *State* _____

PROVED IN AMERICA'S







THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

POWERHOUSES SINCE 1854

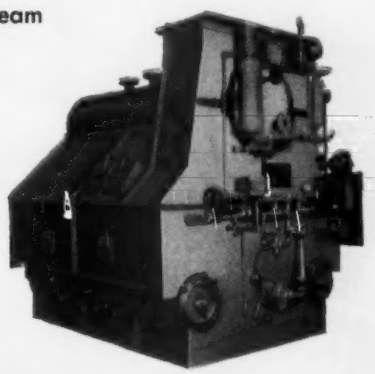
WICKES

STEAM GENERATORS

You'll find the real proof of WICKES' years of experience in the powerhouses across the nation . . . in the foundries and factories, the public utilities, the refineries and natural gasoline plants, in the schools, hospitals and other public buildings that depend on steam for low-cost heat and power. Wickes supplies steam generating equipment to thousands of industries and institutions.

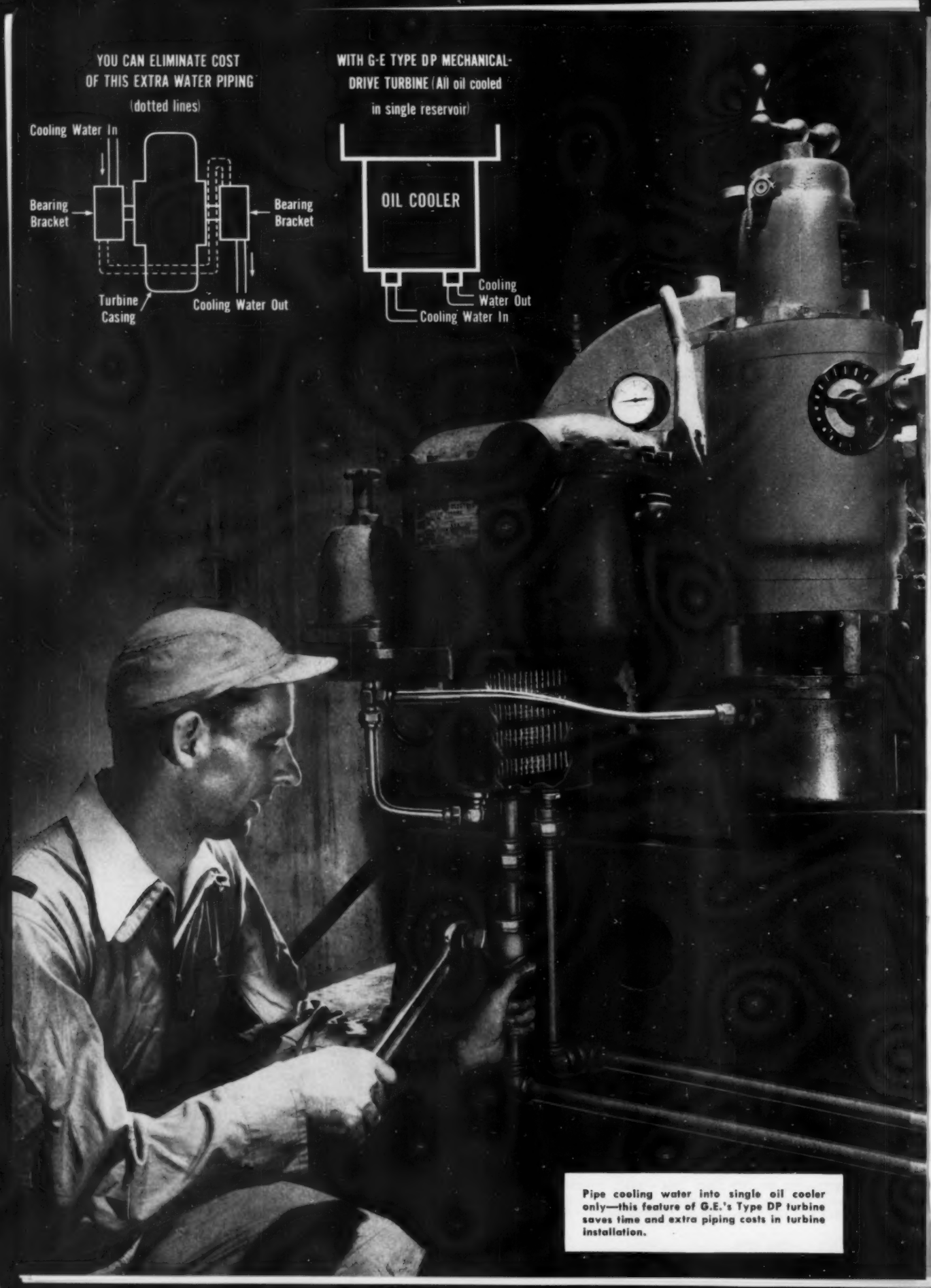
WICKES will design and build water tube steam generators for any practical size and pressure. Wickes also offers a wide choice of auxiliary equipment so that it's possible for you to get not only the best steam generator but also the best correlated equipment.

Contact your nearest Wickes sales representative or write us today.



153

RECOGNIZED QUALITY SINCE 1854 • **SALES OFFICES: Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.**



Pipe cooling water into single oil cooler only—this feature of G.E.'s Type DP turbine saves time and extra piping costs in turbine installation.

ANOTHER PLUS VALUE OF G-E MECHANICAL-DRIVE TURBINES...

Single Oil Cooler Saves Extra Turbine Piping Costs

You save on installation costs with a G-E mechanical-drive turbine because General Electric pipes the bearing oil back to a single reservoir for cooling, in a single oil cooler. This eliminates the extra costs of running cooling water piping to and between each bearing. This feature alone can save you up to $50.00.

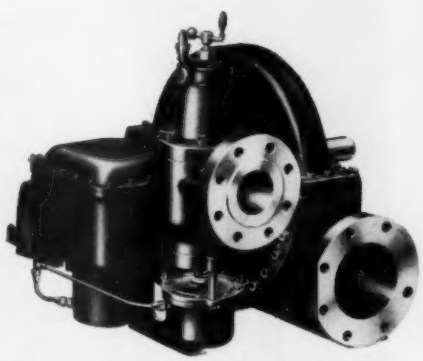
This single oil cooler is just one of the many features on the Type DP turbine which save you money. The chart below indicates other areas of savings.

Remember—the total cost is often more than just the sales price. But G.E.'s standard DP turbines include the extra features that save you extra costs. For more information contact your nearest G-E Apparatus Sales office. Write for bulletin GEA-4955A, "A New Standard in Mechanical-drive Turbines." General Electric Company, Schenectady 5, N. Y. 232-64

GENERAL ELECTRIC

INSTALLATION AND MAINTENANCE COST-SAVING FEATURES

THESE EXTRA FEATURES, STANDARD ON ALL G-E TYPE DP TURBINES, CAN . . .	Save-You up to
COMBINED TRIP-THROTTLE VALVE Eliminate extra cost of buying and installing valve ahead of the turbine.	$200.00
SINGLE RESERVOIR FOR COOLING LUBE OIL Eliminate extra cost of piping cooling water to and between bearings.	50.00
MAJORITY OF PARTS INTERCHANGEABLE One set of spare parts protects several units—less money tied up in inventory.	100.00
METALLIC-LABYRINTH VALVE STEM BUSHING Eliminate labor costs of replacing soft packings; cut down-time production losses.	50.00
SHAFT MONEL-SPRAYED AT PACKING FIT Saves frequent cost of purchasing and installing carbon rings; contributes to long shaft and packing life.	20.00
ESTIMATED TOTAL SAVINGS	$420.00



G-E Type DP Mechanical-drive Turbine

COMPARE THE FEATURES
EVALUATE ALL THE COSTS

See why G-E standard Type DP turbines are your most economical buy.

"this is

● Engineers tell us Yarway Remote Liquid Level Indicators are the most dependable boiler insurance they can have.

Instant . . . accurate . . . brilliant . . . continuous readings of boiler water level are seen on the panel or wherever you wish in your plant. You know the readings are right because they are controlled by the boiler water itself . . . by the pressure differential between a constant head of water and the varying head in the boiler drum. *Indicating mechanism is never under pressure.*

Yarway Indicators may be equipped with a Yarway Control Unit that operates Remote Hi-Lo-Alarm signal lights or horns. For a 24-hour record of boiler water levels, use the Yarway Hi-Lo-Graph Recorder.

On the boiler drum itself you'll want Yarway Water Gages . . . and these "bright as a star" gage readings can now be televised with a Yarway—RCA Television chain.

From drum to panel and at all remote locations, Yarway equipment gives you the safest boiler protection you can buy . . . proved beyond doubt in thousands of power plants.

Write for the specific bulletins you want.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

NEW! WIDER VISION!

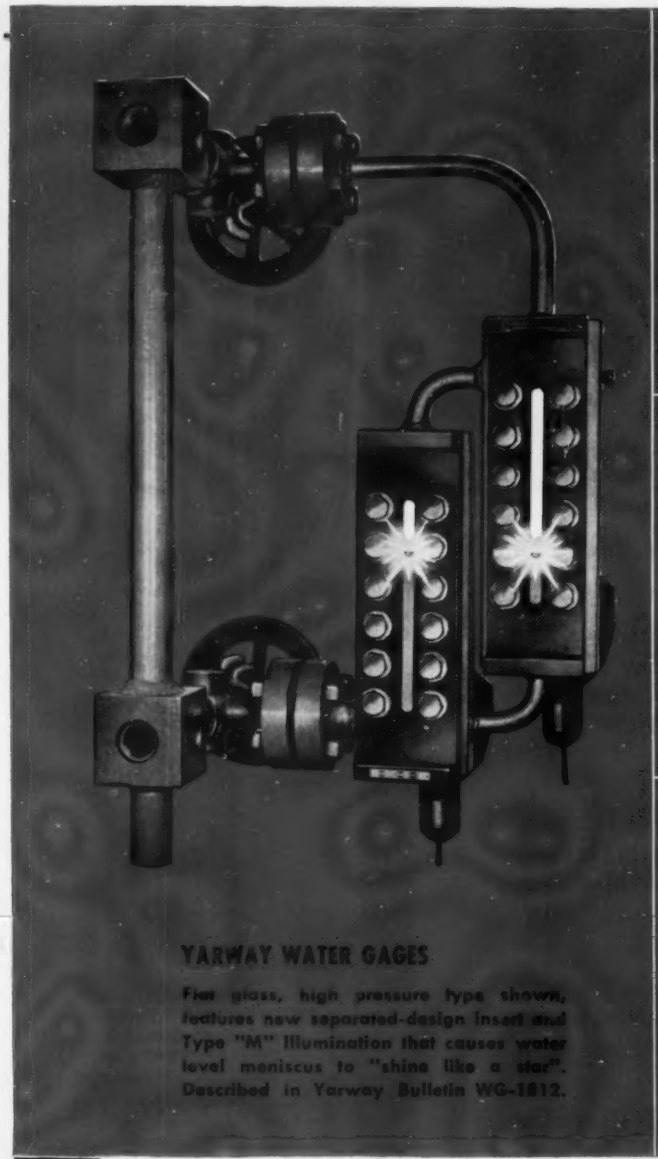
Clear, brilliant readings from any angle, are possible with the new "wide vision" face on the Yarway Remote Liquid Level Indicator. Pointer is always visible, even at extreme high and low water levels.

The Yarway Indicator is manometric type with automatic temperature compensation, as approved for use under the ruling of A.S.M.E. Boiler Code Committee in Case #1155.

Described in Yarway Bulletin WG-1824.

YARWAY®

good boiler insurance!"

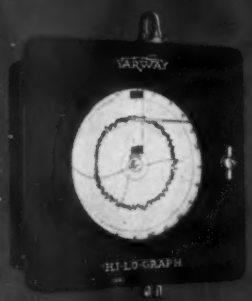


YARWAY WATER GAGES

Flat glass, high pressure type shown, features new separated-design insert and Type "M" illumination that causes water level meniscus to "shine like a star". Described in Yarway Bulletin WG-1812.

YARWAY REMOTE SIGNAL ALARMS

Lights on horns, operated by Control Unit on Yarway Indicator, give instant warning of any serious deviation from normal water level. Can be located anywhere in plant. Described in Yarway Bulletin WG-1824.



YARWAY HI-LO-GRAPH RECORDER

Gives a continuous 24-hour record of liquid levels. Actuating mechanism is same as in Yarway Indicator. Used both for indicating and recording. Described in Yarway Bulletin WG-1830.

YARWAY RCA TELEVISION

Simplified system consists of compact camera and panel-mounted monitor. Clear, bright image of water level gage anywhere in the plant.
Described in Yarway Bulletin WG-1813.

steam plant equipment

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
LIQUID LEVEL INDICATORS
EXPANSION JOINTS
STEAM TRAPS
STRAINERS
SPRAY NOZZLES
DIGESTER VALVES

HOW ACCURATELY DO YOU MEASURE

EXCESS AIR

IN YOUR FLUE GAS?

Prevent heat loss up the stack. Too much or too little excess air means big money in today's boiler plant. It's important to *know* and *control* excess air exactly—regardless of load or fuel changes.

Burn multiple fuels efficiently

When switching from one fuel to another or burning more than one fuel at the same time, only an Oxygen Recorder gives you an undistorted picture of excess air. It measures O_2 directly and continuously, without recalibration.

Hundreds of companies are reaping large savings with Hays Electronic type Oxygen Recorders in their boiler plants. Flue gas sampling systems fit a wide variety of installations.

With the Hays Electronic type Oxygen Recorder you get continuous, highly accurate indication and recording . . . complete compensation for temperature and pressure effects . . . freedom from chemicals or hazardous fuel burning in the analyzing process . . . swift, sure electronic operation.

Write today for Hays Bulletin 52-829-56. Also ask for a dramatic comparison graph which shows that the relationship between O_2 and excess air is practically constant for different fuels.

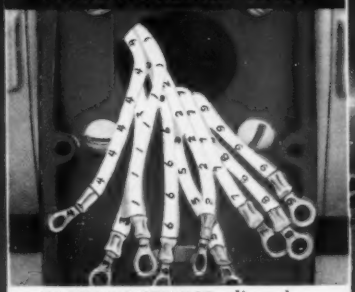
Automatic Combustion Control
Boiler Panels • CO_2 Recorders
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 3, INDIANA

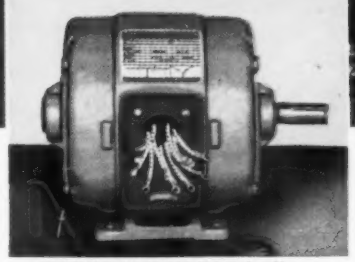
TRI 55 CLAD THE LEADER IN MODERN MOTOR DESIGN

PERMA-NUMBERED LEADS



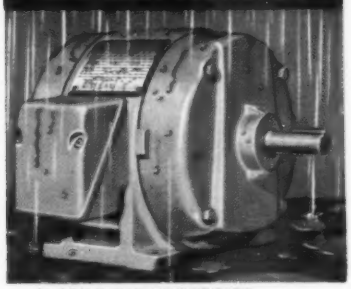
EASIER TO SERVICE, clipped or taped terminals always can be read. You save hooking-up time.

EASY ACCESS CONDUIT BOX



LARGE CONDUIT BOX is diagonally split—gives you ample knuckle room for easier wiring.

60% MORE PROTECTION



MORE FULLY PROTECTED motor achieved through redesign of cast iron frame and end shields.

LONGER MOTOR LIFE

NEW BEARING SYSTEM means the G-E motor runs longer without relubrication than any other.

Now, easier installation, less maintenance...

G.E.'s new TRI 55 CLAD motor— you can install it and forget it!

REG. U.S. PAT. OFF.

The all-new General Electric Tri/Clad '55' motor is specially engineered to reduce your installation costs . . . and run longer, without attention, than ordinary motors. This new motor gives you 60% more physical protection plus longer electrical life. In addition, a bearing system designed to use the most modern greases means you will not have to regrease the Tri/Clad '55' for years.

You save with the new Tri/Clad '55' because wiring is easier and faster. The large, diagonally split conduit box gives you plenty of knuckle room. Leads are perma-numbered . . . you can always identify them instantly.

The new Tri/Clad '55' also brings you important handling, storing and installing economies. Better use of space within the frame means a 30% reduction in size and weight in some ratings. Yet active materials (magnetic steel and copper) are not sacrificed.

General Electric Tri/Clad '55' motors are now available in many ratings. The complete line of 1 to 30 hp a-c motors will be available soon. For full details contact your G-E Apparatus Sales Office or G-E Motor Supplier today. Write for Tri/Clad '55' bulletins GEA-6013—Dripproof motors, GEA-6012—Enclosed motors, GEA-6027—Gear-motors. General Electric Company, Section 648-7, Schenectady 5, N. Y.

Progress is our most important product

GENERAL ELECTRIC

G-E Motors Are Custom-built for Power Station Service!

OUTDOORS OR IN, General Electric power station motors are built to give you dependable, economical service. For example, the two vertical Tri-Clad* totally enclosed fan-cooled motors, shown here, have given consistent reliable performance under all weather conditions at the A. B. Paterson Steam-Electric Generator Station of New Orleans Public Service Inc.

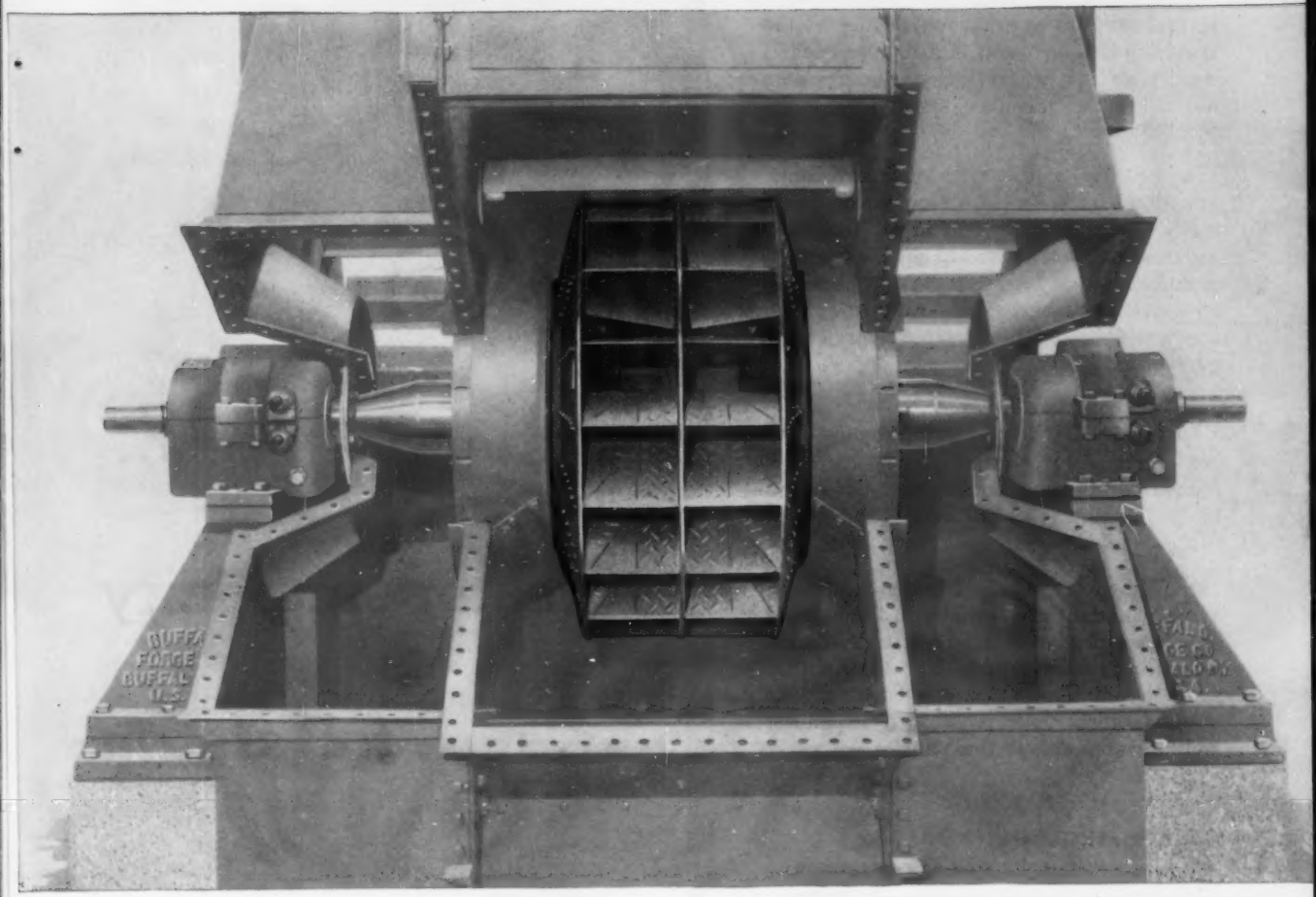
GENERAL ELECTRIC'S 70 YEARS of experience in designing, building, and servicing motors for power station requirements assures you of getting the right motor for the job. Whatever your needs in power station motors, G.E. can furnish a complete line including dripproof, totally enclosed fan-cooled, totally enclosed air-water cooled, and weather protected motors in both horizontal and vertical construction.

FOR MORE DETAILED information on G.E.'s power station motors, contact your nearest G-E Apparatus Sales Office. *General Electric Co., Schenectady 5, New York.* 830-1

*Registered Trade-mark of the General Electric Company

GENERAL ELECTRIC

How a FAN ROTOR Delivers CHEAPER POWER



. . . in "Buffalo" Induced Draft Fans

Inside the "Buffalo" Induced Draft Fan is a hurricane — a hurricane of hot, erosive fly-ash being drawn from the boiler firebed by a rotor like the one above. We don't have to tell you how quickly this could literally destroy an ordinary rotor—nor how expensive replacement would be.

Yet the "Buffalo" rotor is built to "take-it" for a long period. Heavy gauge steel used throughout; backward curved blades for extra stiffness and efficiency — tapered side flanges cut from a solid plate — floor plate wearing strips with angular ridges to reduce erosion — heavy hub solidly bolted to the center plate. And all other parts of the fan — housing, shaft and bearings — are built to "go the distance" for you, which naturally means cheaper power. It's all part of the "Q" Factor* that's in every "Buffalo" Fan. You'll see full details in Bulletin 3750. Write for your free copy today!

**The "Q" Factor—The built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo"

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

Publishers of "Fan Engineering" Handbook

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

When you need instrument service . . .

Ever have a tire blow out while you're traveling late at night? If it happens near a service station, you're lucky. But if it's on a lonely road far from town, you've got trouble.

When it comes to service on instruments, you don't need to take chances on being lucky. Because when you have Honeywell instruments, you've always got the comfortable feeling that service is close at hand . . . whenever and wherever you want it . . . from the world's biggest instrument service organization.

OVER 110 SERVICE CENTERS

No matter where you may be, there's a Honeywell service man near you. Offices are located in more than 110 cities of the United States and Canada, near every large production center.

When you run into trouble, just telephone or wire the nearest of these offices. You'll get a service specialist promptly . . . often within a few hours. This quick attention to your needs protects your production schedules, and prevents delays that can cause costly stoppages.

TRAINED PERSONNEL

Honeywell service men are thoroughly trained for their important responsibilities. In the Honeywell factories, hand-picked men learn both the theory and practice of instrument maintenance. Then they serve an apprenticeship in the field offices, to gain further first-hand experience. You can be sure that the Honeywell man who calls at your plant is a qualified specialist, well versed in the practical art of keeping good instruments in the best condition.

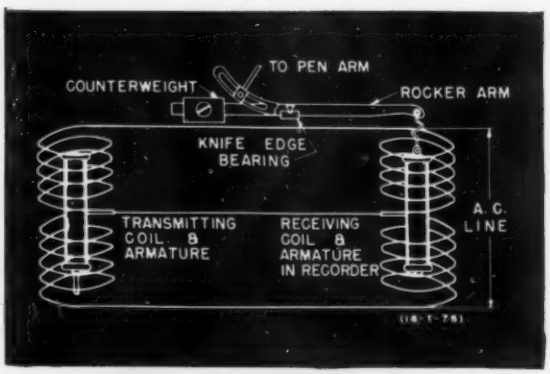
PERIODIC SERVICE

But why wait for emergencies—when you can prevent them with periodic service. Under a simple contract, a Honeywell man will visit your plant at regular intervals to inspect, clean and adjust your instruments and controls. The plan is economical, and can save you hours of production time. Our nearby office will be glad to give full details on Honeywell Periodic Service.

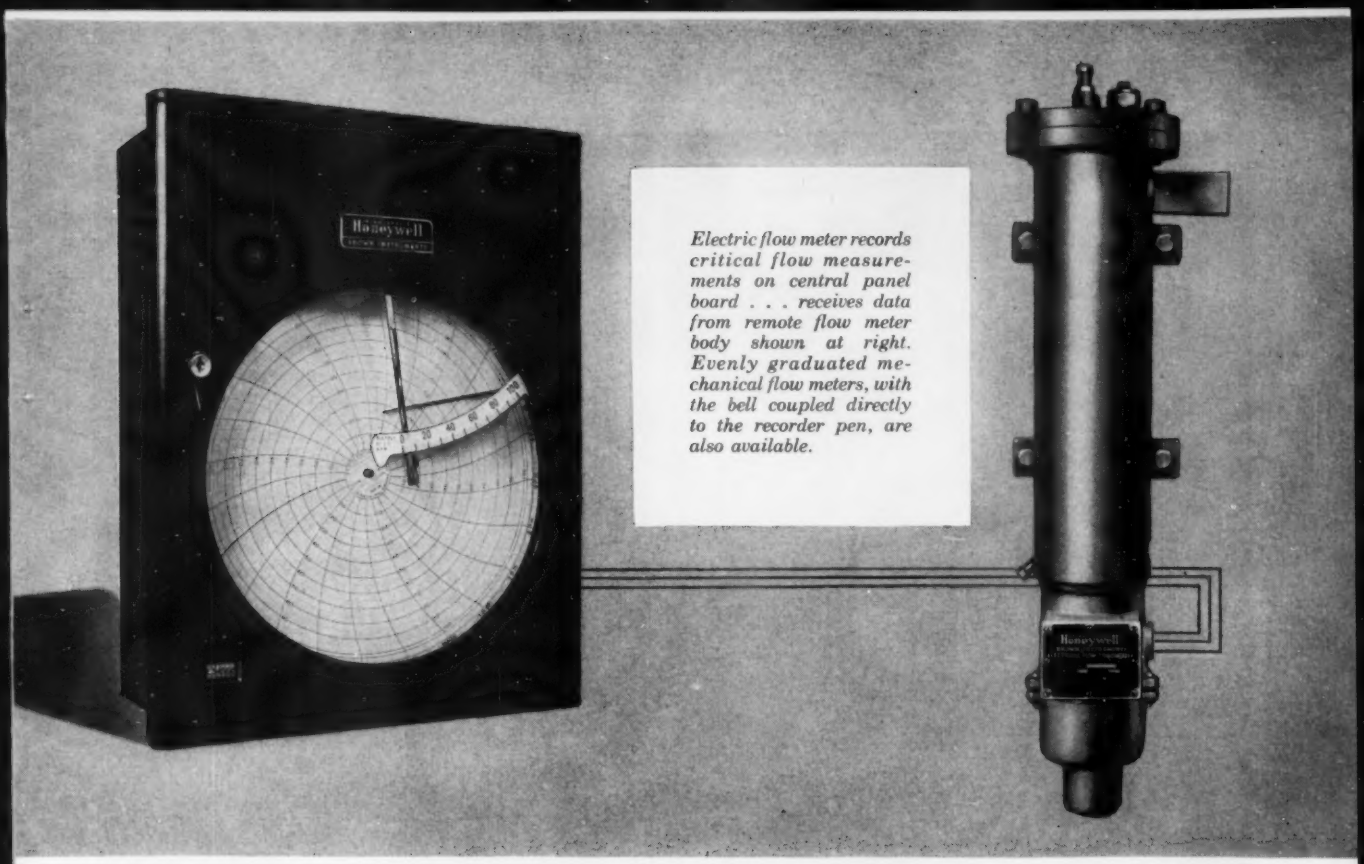
Better accuracy...

greater simplicity

.....*for steam*



ELECTRICAL TRANSMISSION SYSTEM *brings flow data instantaneously and accurately from the remote meter body to the Brown Flow Meter. The inductance bridge system consists of a transmitting coil and armature at the meter body, and an identical coil and armature in the instrument. The receiving armature faithfully duplicates the movement of the transmitter.*



Electric flow meter records critical flow measurements on central panel board . . . receives data from remote flow meter body shown at right. Evenly graduated mechanical flow meters, with the bell coupled directly to the recorder pen, are also available.

plant flow measurements

WHEREVER your steam plant uses measurement of flow . . . for steam, feedwater, make-up water or oil . . . Brown Electric Flow Meters offer every performance feature you could require. Compare these advantages:

Electronic integration . . . using high-speed, high-sensitivity electronic scanning . . . provides exceptional precision in totalizing flow. This unique integrator completely eliminates friction loading of the recording system. It's extremely simple; has only three major parts, and can be calibrated in only a few minutes.

Electrical transmission . . . ideal for centralized control . . . permits the meter body and instrument to be located hundreds of feet apart without loss of sensitivity. A precision-made inductance bridge transmission system (illustrated on the opposite page) gives faithful reproduction of remote measurements, and eliminates the problems of panel pipe connections.

Evenly divided chart assures easy readability and high accuracy at all flow values . . . no crowding of divisions at the low end of the scale.

Brown Electric Flow Meters are available in both square root and evenly graduated type meters with ranges applicable to practically all steam, water and oil measurements. Your nearby Honeywell sales engineer will welcome the opportunity to discuss your specific needs . . . and he's as near as your phone.

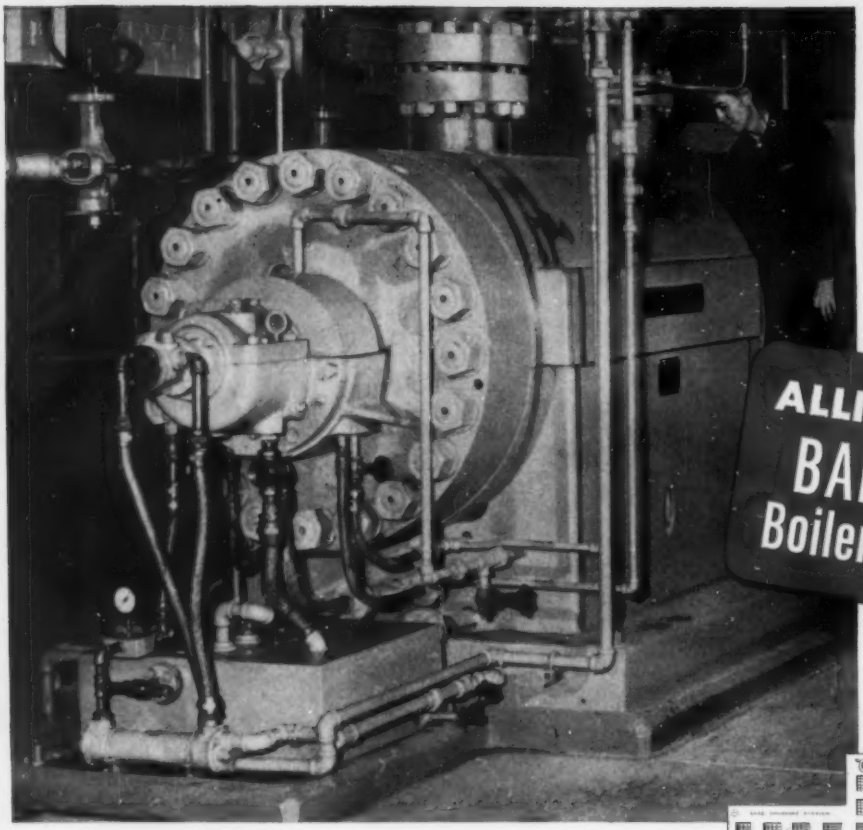
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for new Catalog 2320, "Flow Meters, Indicating, Recording, Controlling."**

MINNEAPOLIS **Honeywell**

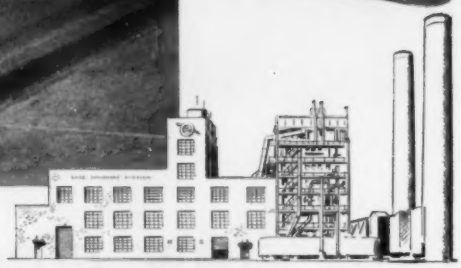
BROWN INSTRUMENTS

First in Controls



One of three barrel-type boiler feed pumps at the Lake Catherine station of Arkansas Power and Light Company. Rated at 525,000 lb/hr, 1800 psig discharge, 3575 rpm, water temperature 350 F. Station engineered by Ebasco Services, Inc.

ALLIS-CHALMERS
BARREL-TYPE
Boiler Feed Pumps



Chosen by Arkansas Power and Light because performance is service proved

Low maintenance, high efficiency

Low maintenance, high efficiency performance records in power plants in all parts of the country . . . that's what led Arkansas Power and Light Company to choose Allis-Chalmers barrel-type boiler feed pumps for their newest outdoor-type station.

Proved design features

Back of that performance record stand many proved design features. For instance, first stage has twin, single-suction impellers to give low NPSH requirement for highest efficiency under fluctuating loads. Impellers mounted back-to-back balance axial forces without balancing drum. Expansion joint and shaft seals are brought to outside of pump where they may be inspected often and worked on easily, if required.

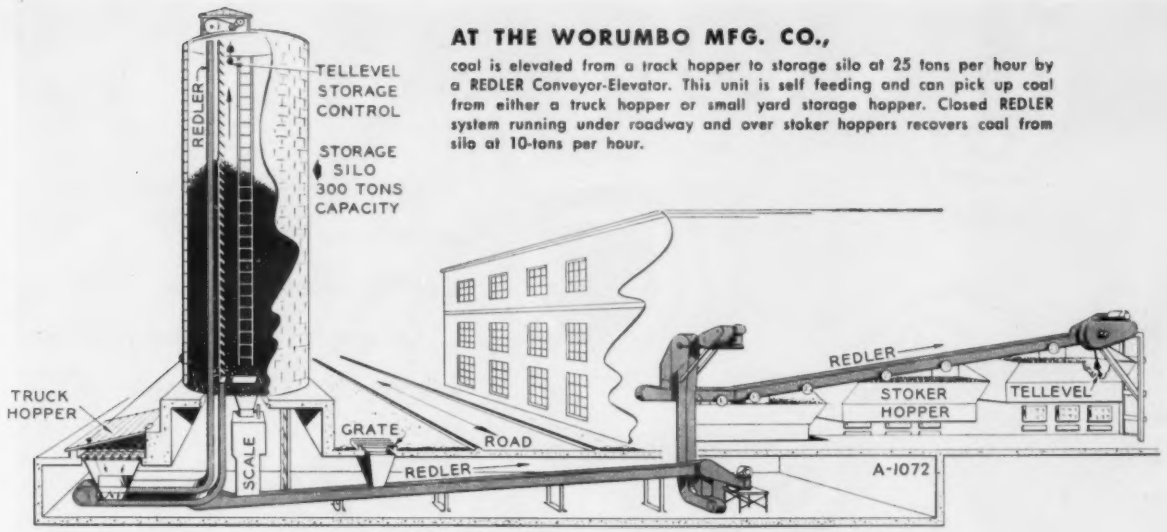
Complete unit from one source

Allis-Chalmers can supply the complete pumping unit — pump, motor and control — of coordinated design and manufacture. You get one responsibility — one guarantee of satisfaction.

Get complete information on Allis-Chalmers barrel-type boiler feed pumps. Call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wisconsin for Bulletin 08B7899.

A-4286

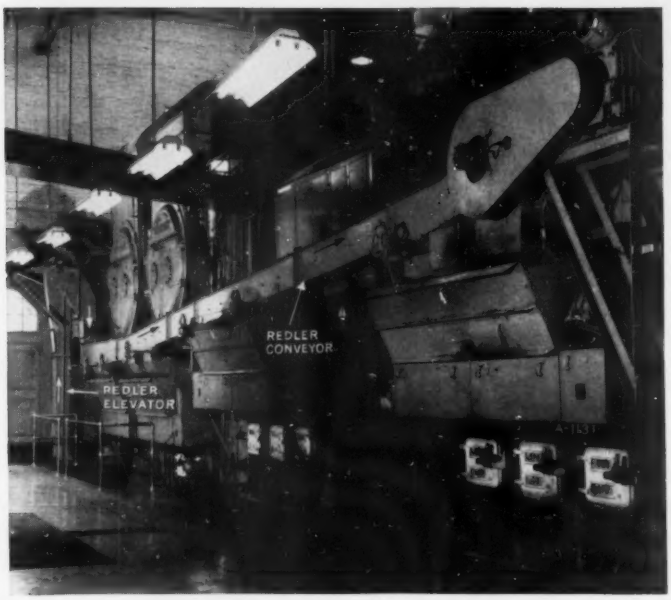
ALLIS-CHALMERS



AT THE WORUMBO MFG. CO.,

coal is elevated from a track hopper to storage silo at 25 tons per hour by a REDLER Conveyor-Elevator. This unit is self feeding and can pick up coal from either a truck hopper or small yard storage hopper. Closed REDLER system running under roadway and over stoker hoppers recovers coal from silo at 10-tons per hour.

They Save $50,000 a Year!



Four Stokers are fed by horizontal REDLER running above hoppers. Rack and pinion gates permit selection of hoppers to be filled. When last hopper is full, Tellevel control shuts off system. Note the clean, dustless appearance of the firing aisle, made possible by the sealed-in feature of REDLER Conveyors.

Modernization of the entire steam plant at Worumbo Mfg. Co., Lisbon Falls, Maine has cut coal consumption 21%, labor costs 60% for annual savings of $50,000. An important part of the labor savings is made possible by an S-A REDLER coal handling system. Operating automatically, this compact system moves coal within sealed casings to practically eliminate coal dust inside the plant. REDLER flexibility also solved a difficult location problem in the Worumbo plant since coal unloading and storage is separated from stokers by a roadway. Other REDLER advantages contributing to lower costs are reasonable first cost and low maintenance.

If dustless coal handling, low operating costs and location flexibility are requirements for a coal handling system in your plant, be sure to investigate S-A REDLERS. We'll be glad to send you full information. Just fill out and mail the coupon.

STEPHENS-ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois
Los Angeles, Calif., Belleville, Ontario

Engineering Division	Specialists in the design and manufacture of all types of bulk materials conveying systems.
Standard Products Division	A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.
SealMaster Division	A complete line of industrial ball bearing units available in both standard and special housings.

Stephens-Adamson Mfg. Co.
5 Ridgeway Avenue, Aurora, Illinois

Please send me your Bulletin No. 140 on REDLER Conveyors.

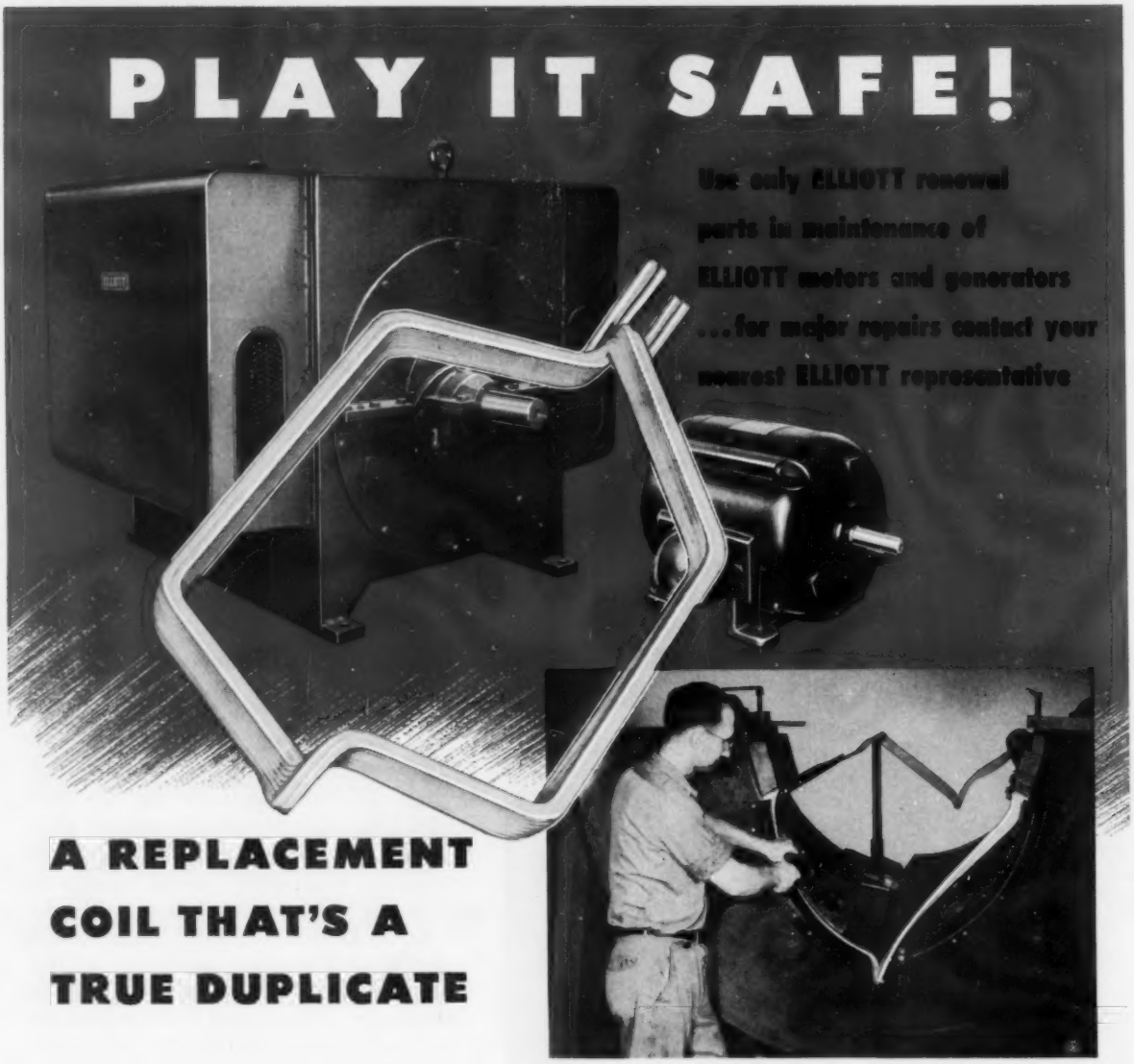
Name_____

Company_____

Address_____

City_____ Zone____ State_____

PLAY IT SAFE!



Use only ELLIOTT renewal parts in maintenance of ELLIOTT motors and generators ...for major repairs contact your nearest ELLIOTT representative

A REPLACEMENT COIL THAT'S A TRUE DUPLICATE

of the original coil is the only assurance of continued high performance. The special form in the photo above produces coils absolutely uniform in shape. Only one of these coils can correctly replace another coil from the same machine.

ELLIOTT ROTOR COILS ARE BAKED UNDER PRESSURE for homogeneous structure and close tolerance, and are properly treated at several points of manufacture with best grade insulating varnishes.

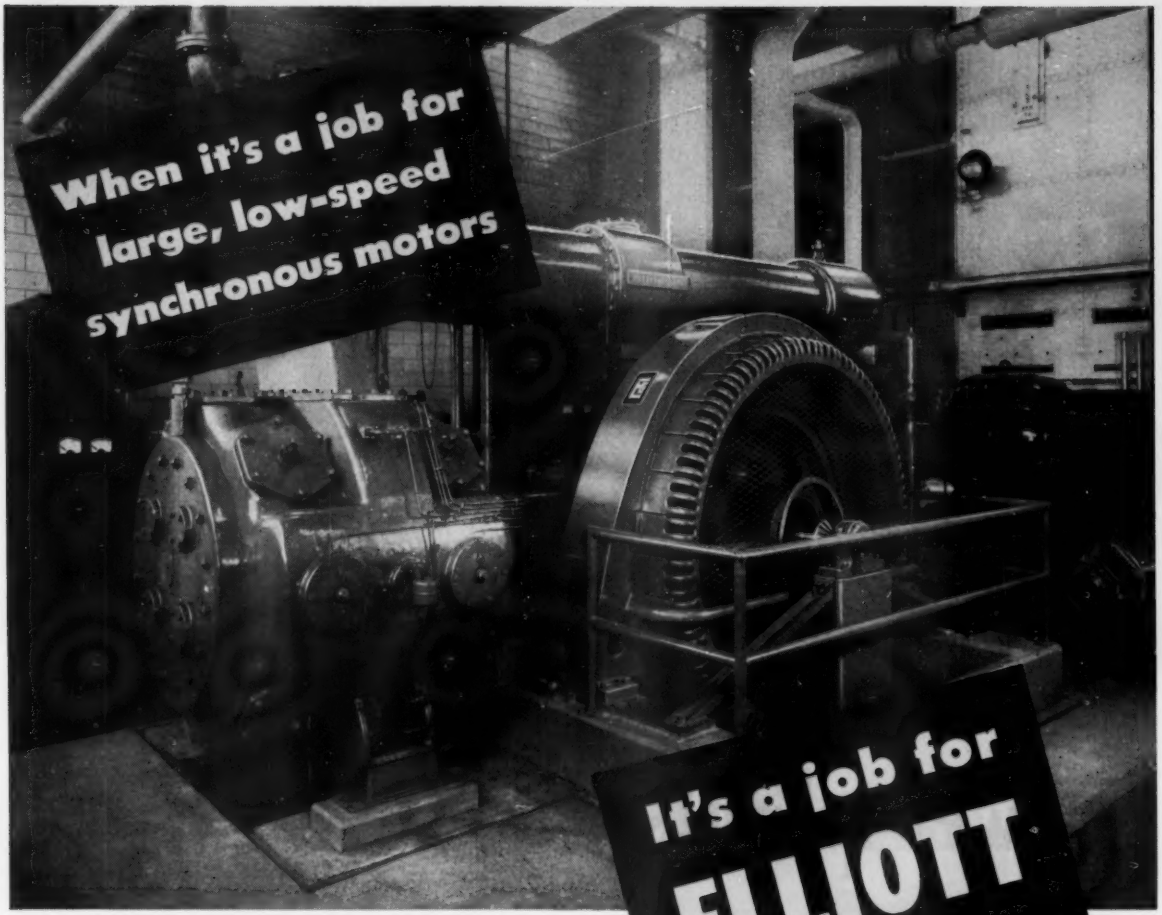
ONLY THE BEST AVAILABLE INSULATING MATERIALS, proven so in constant test, are used in Elliott coils. Insulation practice is considerably beyond standard practice for the voltage of the machine, insuring longer life, highest performance.

FOR BEST RESULTS have coils installed by Elliott factories or Elliott approved service shops. Ask your local Elliott field engineer for location of the shop best suited to serve you.

ELLIOTT Company

Q4-2

TURBINE-GENERATORS TURBINES MOTORS GENERATORS DEAERATING HEATERS EJECTORS CONDENSERS COMPRESSORS TURBOCHARGERS TUBE CLEANERS STRAINERS



Elliott 600-hp, 300-rpm, low-speed synchronous motor driving an Ingersoll-Rand compressor.

Outstanding construction features:

- Mica wrapper or tape on slot portion of stator coils for long life.
- Large area starting winding joints resistance brazed with silver alloy for strength and high electrical and thermal conductivity.
- Fine workmanship throughout.

• Like all large Elliott motors, these motors are designed to fit the installation. Starting, accelerating, pull-in and pull-out torques, power factor correction and other important factors are all tailored to the requirements. And whether open or totally-enclosed, Elliott low-speed synchronous motors may be given a number of mechanical protection, cooling and mounting arrangements. Back of this design flexibility are the built-in ruggedness and efficient operational characteristics which combine to make these motors the perfect teammate for compressors, pumps, Jordans, rolling mills, ball mills, etc. For complete details and ready reference, write to Elliott Company, Ridgway, Pa., for the low-speed Synchronous Motor Bulletin.

ELLIOTT Company

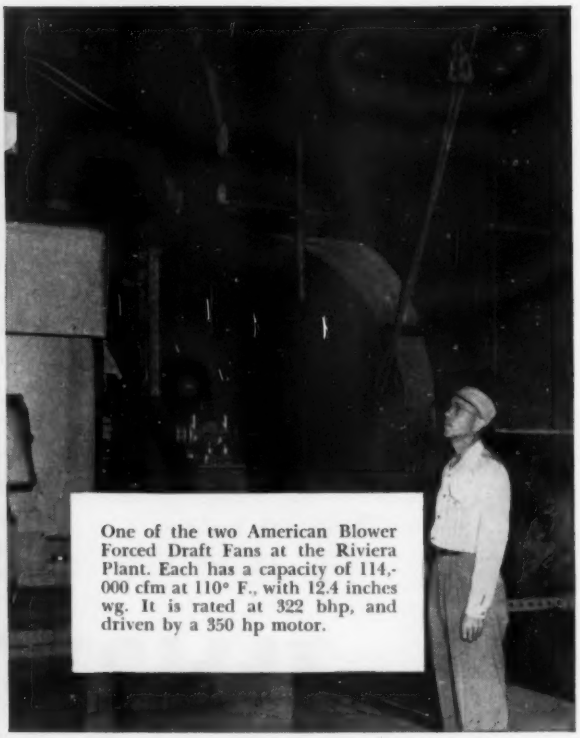
R3-6

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

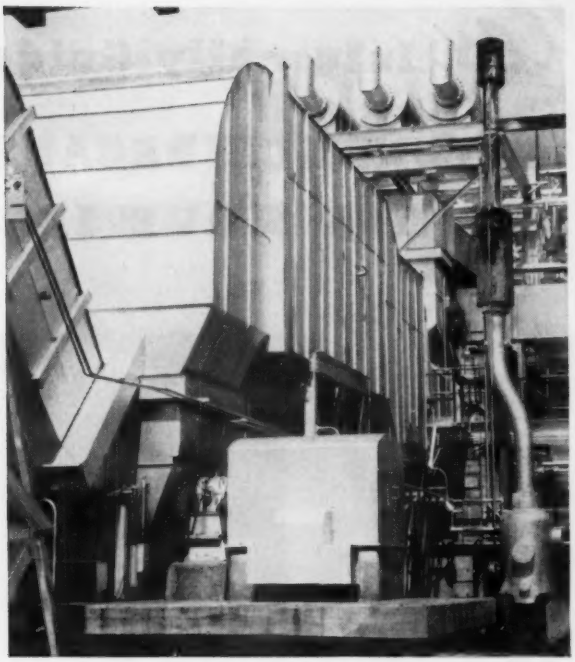
Florida Power & Light Company's beautiful Cutler Plant is the state's largest single generating plant. Its expansion to 240,000 kw. in 1954 will help the rapidly growing power needs of the thriving Greater Miami area.

Power plants, like everything

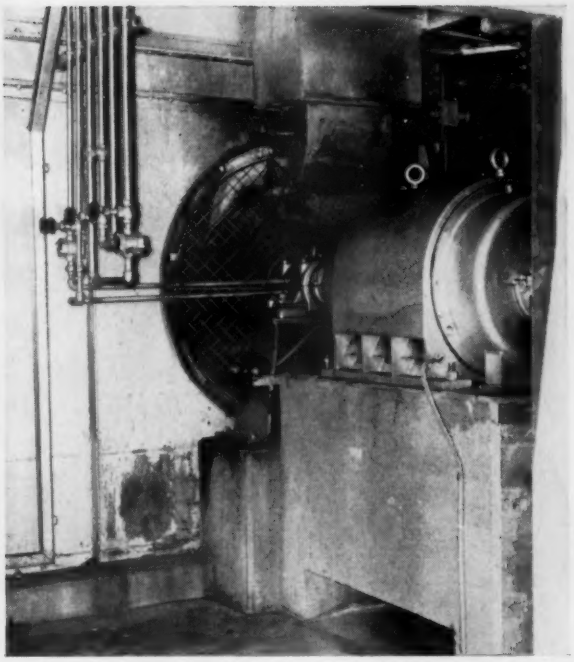
One of the Riviera Plant's American Blower Induced Draft Fans. It has a capacity of 160,000 cfm at 306° F., with 15.4 inches wg. It is rated at 566 bhp and driven by a 600 hp motor.



One of the two American Blower Forced Draft Fans at the Riviera Plant. Each has a capacity of 114,000 cfm at 110° F., with 12.4 inches wg. It is rated at 322 bhp, and driven by a 350 hp motor.



American Blower Induced Draft Fans at the Cutler Plant have a capacity of 68,000 cfm at 350° F., with 9.7 inches wg. Four ABC Fans serve the steam generators for two 15,000 kw. units.



Each of the American Blower Forced Draft Fans at the Cutler Plant has a capacity of 40,500 cfm at 100° F., with 8.7 inches wg, and is rated at 114 bhp and driven by a 150 hp motor.

else, expand fast in Florida!

In fabulous Florida, everything grows fast . . . industry, agriculture, population — and electric power!

Florida Power & Light Company, for instance, has added 10 new generating units since V-J Day . . . and more are coming. Generating capacity is up 212 percent, more than double the national average. With a giant 135,000 kw. plant scheduled for completion in 1955, F P & L's system capacity will total 877,000 kw., or more than four times its end-of-the-war figure.

The Company's Cutler Plant, just south of Miami, is Florida's largest — a model of "outdoor" plant construction, blending ideally with its semi-tropical surroundings on the shores of picturesque Biscayne Bay.

American Blower products play a big part in F P & L's power progress. In the new 80,000 kw. unit at Cutler, two American Blower Induced Draft and two Forced Draft Fans are being installed. At the Company's new 80,000 kw. unit at the Riviera Plant near West Palm Beach, four similar American Blower Fans are already in service.

Are you planning to modernize or enlarge your facilities? Then get in touch with your nearest American Blower Branch Office (or write us direct) for full information on Mechanical Draft Fans, Dust Collecting Equipment and Gyrol Fluid Drives for boiler feed pumps and fan control.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

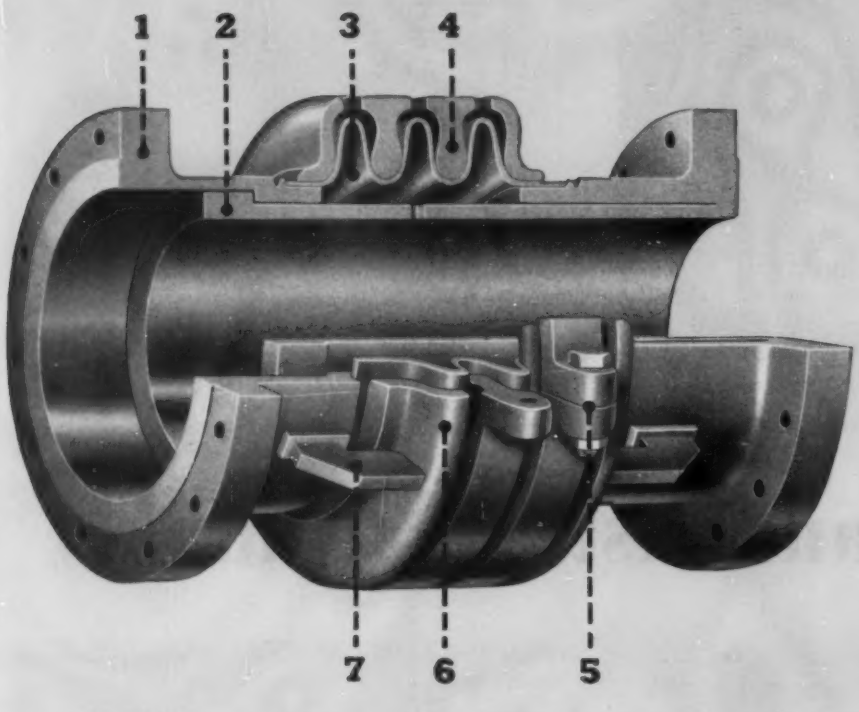
Division of American Radiator & Standard Sanitary Corporation

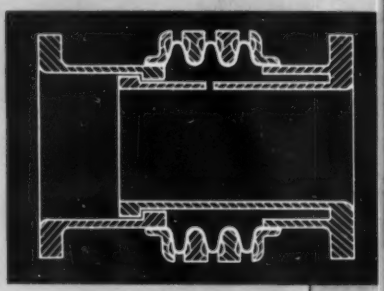
AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

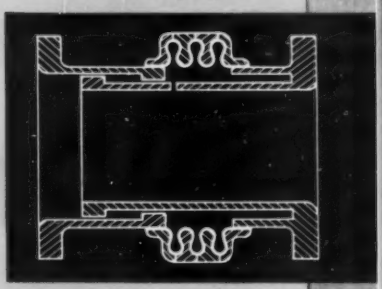
ADSCO *Corruflex* Internally-Guided

NO MAINTENANCE BECAUSE RIGID AGAINST ALL MOVEMENT





Internally-Guided Joint Before Absorbing Expansion



Internally-Guided Joint After Absorbing Expansion

1 Available with flanged (illustrated) or welding ends.

2 Guide ring carefully welded to inner sleeve rides machined bore of body to insure true axial movement. Internal sleeve of heavy wall construction for effective guiding and rigidity. Vent in sleeve equalizes pressure on both sides of sleeve.

3 Corrugated element is a single piece of metal hydraulically formed to produce uniform wall thickness and smooth curves held to close tolerances. During forming operations, the element is annealed at intermediate stages to prevent over-working of the metal. When joint is operated, flexing stresses are therefore evenly distributed, rather than concentrated at welds, as in other types of joints.

4 Equalizing rings reinforce the element and control the movement of the individual corrugations. The inner surface is carefully hand-finished to give complete support to element. Rings are made in a single piece, cut into halves, and kept in pairs to maintain a perfect match.

5 Extra heavy lugs on equalizing rings provide maximum strength.

6 Bell end is exactly shaped to fit the contour of the end corrugation.

7 Gussets transmit thrust directly from bell end to nipple.

ADSCO ENGINEERED PRODUCTS

AMERICAN DISTRICT STEAM COMPANY, INC.

GENERAL OFFICES
NORTH TONAWANDA, NEW YORK

PLANTS: NORTH TONAWANDA, N. Y., AND RICHMOND, CALIF.

ADSCO LEADERSHIP SINCE

Expansion Joint

IT'S PACKLESS... EXCEPT AXIAL

One of the greatest advances in pipe line expansion joints in the last ten years has been the Corruflex Internally-Guided Packless Expansion Joint, engineered and manufactured by ADSCO, the world's greatest name in expansion joints.

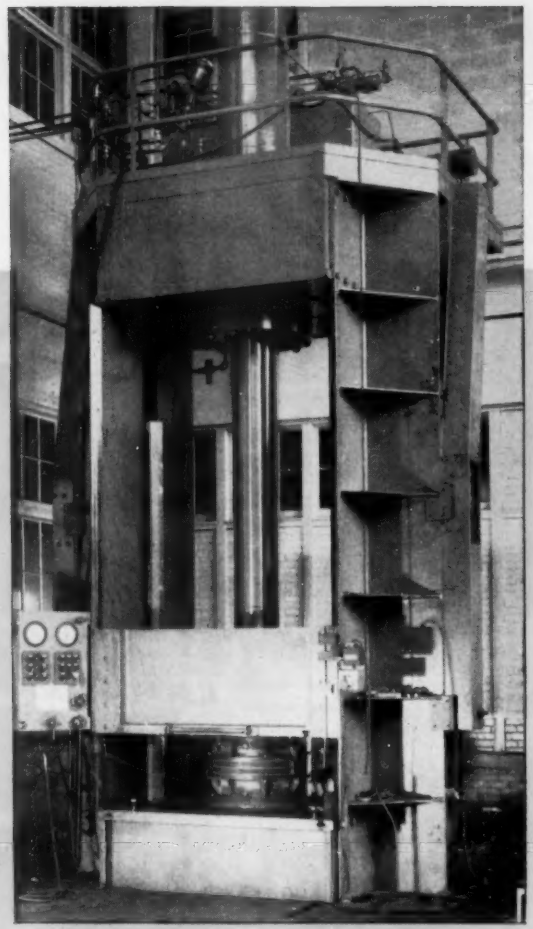
This new member of the famous Corruflex line is packless and therefore requires no maintenance. It provides rigid construction against all movement except axial. The Corruflex Internally-Guided Joint has many applications: in liquid and gas lines in petroleum and chemical processing plants, in steam lines in factories, power plants, and large buildings — wherever the installation calls for the Internally-Guided Joint's double feature: rigidity and freedom from maintenance.

The Corruflex Internally-Guided Joint achieves its rigidity through an internal sleeve of heavy wall construction. The inner end of this sleeve has a guide ring riding on a machined bore to insure effective guiding and axial movement only. Limit stop in bore prevents the joint from being extended beyond its predetermined limit. Equalizing rings limit the movement of each corrugation in compression and reinforce the element against internal pressure.

The Corruflex Internally-Guided Joints are made in sizes ranging from 3" to 54" diameter, in single or double units, with single or multiple corrugations, with flanged or welding ends, with or without base, and with or without branch-line outlet connections. They can be supplied with covers to permit the joints to be fully insulated and to prevent foreign matter from being lodged between the corrugations. Depending on the metal used in the expansion element, these joints are suitable for temperatures from sub-zero to 1600F and for pressures to 300 psi.

Single Internally-Guided Joint With Cover and Base.

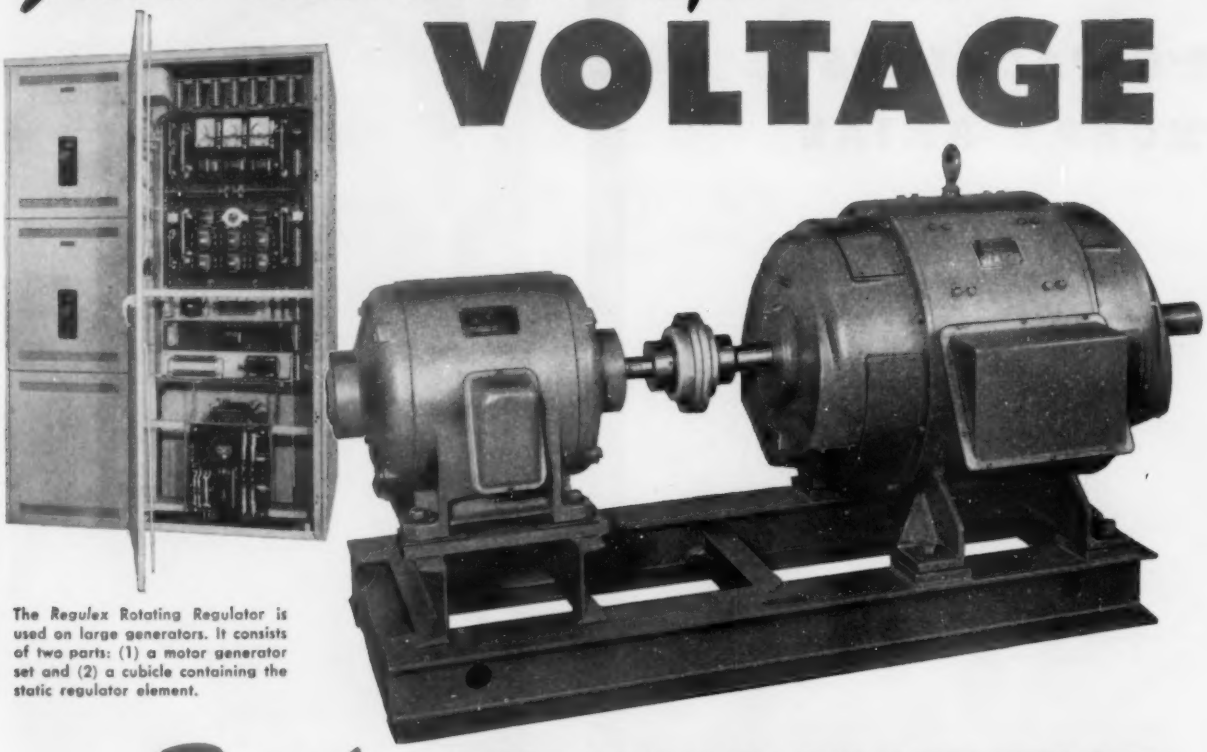
1877



10,000 High Pressure Flexings Prove Corruflex Reliability

To prove their durability, ADSCO Corruflex joints have been tested rigorously on a special vertical press (shown above) in the ADSCO factory, many of the tests having been performed in the presence of government engineers and inspectors. In one test, for instance, a standard 3-corrugation joint of 600-lb. rating was first hydrostatically tested to 150% of its design working pressure of 535 psig. Next, it was flexed at its rated traverse of 1⅛" through 10,000 complete cycles of extension and compression. (Rated traverse per corrugation depends on the number of cycles and the operating pressure.) In the test, the hydrostatic pressure was increasingly applied and reached its maximum when the joint was fully compressed. These testing methods imposed the most severe working conditions. Despite this severe testing, the joint showed no defects whatever. To guarantee that there were absolutely no defects, two additional special tests were made. First the joint was air-tested at 100% of its design conditions in the extended and compressed positions and the air-pressure loss was found to be less than 2 psi per hour. It then was vacuum-tested to 0.5 psia and the pressure gain was less than 0.05 psi per hour. In still another test, a standard Corruflex joint of six corrugations was flexed at its rated traverse of 3.4" through 22,000 cycles at 20 psig. In each test, the flexing was stopped, not because of a failure in the joint but because the joint had been shown to have complied fully with the customers' requirements.

Fast, accurate, dependable VOLTAGE



The *Regulex* Rotating Regulator is used on large generators. It consists of two parts: (1) a motor generator set and (2) a cubicle containing the static regulator element.

Regulex ROTATING REGULATOR

★ **Maximum Productivity from New Generators**
★ **New Efficiency from Present Installations**

Regulex voltage regulators incorporating automatic minimum excitation permit generator operation close to the stability limit . . . much closer than manual operation allows. The sensitivity and exceptional response of the *Regulex* voltage regulator and associated equipment establish and maintain a safe ratio between generator load and field current . . . increase operating limits at any given power factor load . . . assure the proper reactive kva division. The *Regulex* voltage regulator does not require multiple special fields in the exciter — may be applied to any standard shunt machine. Write for literature. A-4189

New Magnetic and Electronic Amplifiers

Versatile "Tools" Used in Solving Your Particular Voltage Regulation Problem

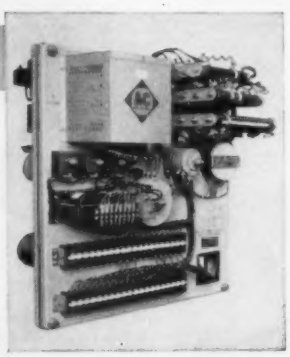
For special industrial and military regulating systems, added flexibility is obtained by using magnetic and electronic amplifiers. These components *supplement* but do not replace the *Regulex* rotating amplifier in most applications.

The magnetic amplifier is used primarily where reversible output from the amplifier is not required. Special exciter design is eliminated in such applications.

The shock-proof characteristics of the magnetic amplifier make it particularly adaptable to military voltage control.

Electronic amplifiers are used only on applications that require exceptionally high sensitivity.

Applications of magnetic and electronic amplifiers for purposes other than voltage control include speed, current, and tension regulation.



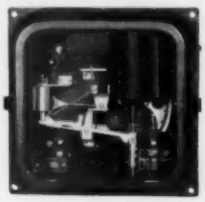
Voltage regulator with current limiting device. Used for control of static rectified dc power supply.

REGULATION
For ANY Size Generator

Rocking Contact VOLTAGE REGULATORS

dc Applications

The Type VD Regulator has been designed to meet the demands of voltage or current characteristics of dc machine operation. Resistors are cut in and out of the exciter shunt field by the *Rocking Contact* sector. No sluggish, time wasting relays. No vibrating or sliding contacts to wear out. A small movement of the *Rocking Contact* sector over a curved commutator covers the entire regulating range. Type VD regulators are available for all dc generators. Write for Bulletin 14B6137A.



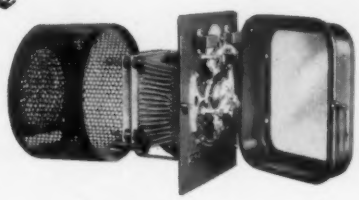
VD-2 Regulator for dc generators from 10 kw at 80 rpm to 200 kw at 3600 rpm

ac Applications

Types V-00 and 221 Regulators

FOR SMALL GENERATORS

Rocking Contact Voltage Regulators are available in two types for use on small ac generators with direct-connected exciters — Type V-00 for generators to 157 kva maximum at 3600 rpm; Type 221 for generators to 438 kva maximum at 3600 rpm. These regulators can be modified for temperature compensation, shock mounting or other special requirements. Bulletin 14B6143A gives details.



Types A, B, & C Regulators

FOR MEDIUM SIZE GENERATORS

Types A, B, and C Regulators differ only in kva range.

Type A Regulator—for ac generators, 125 kva at 257 rpm to 1750 kva at 3600 rpm.

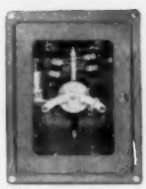
Type B Regulator—for ac generators, 1000 kva at 257 rpm to 6250 kva at 3600 rpm.

Type C Regulator—for ac generators from 3125 kva at 257 rpm to 25,000 kva at 3600 rpm.

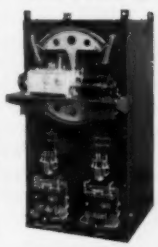
All have guaranteed sensitivity of plus or minus 0.5%. Write for Bulletin 14B6035B.

FOR LARGE GENERATORS

Type J *Rocking Contact* Regulators are of the exciter field rheostatic type designed for the control of large synchronous machines. This regulator consists of two parts: (1) a voltage sensitive torque motor control element for panel mounting; (2) a motor-operated exciter rheostat with high speed field forcing contactors. Write for Bulletin 14B6015A.



Type J Element



Motor-Operated Rheostat

Regulex and *Rocking Contact* are Allis-Chalmers trademarks.

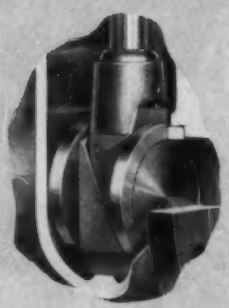
ALLIS-CHALMERS

Milwaukee 1, Wisconsin

DARLING VALVES

2 VALVE PRINCIPLES

that save money for DARLING Cast Steel Valve users!



❶ ***Darling Fully Revolving Double Disc, Parallel Seat Gate Valve.*** **Just four simple working parts . . . two interchangeable, no-pocket discs and two husky wedges. Maintenance is easier, assembly is foolproof, and tight seating is assured.**

❷ ***Darling Slotted Wedge Type Gate Valve.*** **Notice the unique center slot which permits wedge to seat under compression and adjust to valve seats as valve body expands and contracts.**

Select the DARLING Valve to meet your specific needs

WHETHER you select the fully revolving double disc, parallel seat type . . . or the slotted double grooved wedge type . . . you'll have a Darling gate valve with outstanding features that are minimizing down time and cutting maintenance costs on job after job.

Check cutaway view No. 1. This famous Darling self-adjusting, revolving disc parallel seat gate valve is rated by users as the most trouble-free, best performing gate valve obtainable. Its simple, efficient design assures *automatic* compensation for valve body distortion. In addition, wear on valve parts is *uniform*, which means much longer service life.

Now take a close look at cutaway view No. 2. This Darling valve will do everything that an ordinary solid wedge valve can do . . . *and more.* The wedge is slotted to assure better seating under valve body expansion and contraction. Tight closure and easy operation are assured, and there is far less wear on wedge faces and seats. *Also,* the *double* grooves, with *twin* guide ribs in the valve body, provide twice the usual bearing area. Canting of wedge caused by line pressure is thus eliminated, preventing damage to the downstream seat.

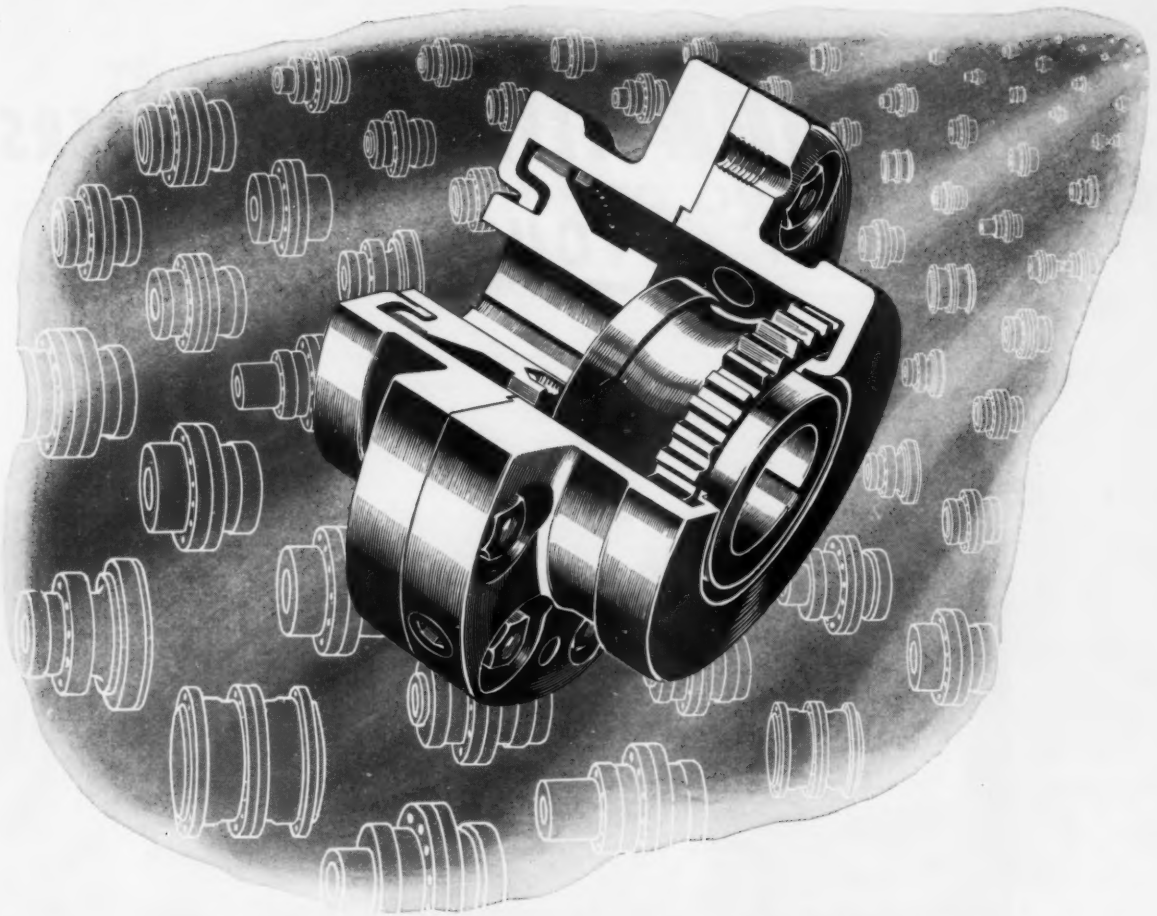
You'll be wise to get all the facts about these two types of money-saving Darling cast steel gate valves before you decide on any valve. Write today for general literature, or request information on your specific valve needs.

NOTE: Darling gate valves are made in a wide range of sizes, types and constructions for all kinds of normal and unusual service . . . and for pressures up to 1500 pounds.

DARLING VALVE & MANUFACTURING CO.

Williamsport 8, Pa.

Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario



Hundreds of thousands of installations prove . . .

FAST'S Couplings are FIRST!

There's no stronger endorsement of Fast's Couplings than the close to three-quarter million Couplings installed in the 33 years since their design revolutionized the power coupling business!

Trouble-free performance that saves down-time, maintenance, and money led to that record. And, whatever your coupling applications, it's a guarantee of what *you* can expect from Fast's! Fast's Couplings give you *rugged construction* . . . because their original design has been maintained without basic change or sacrifice in size or materials. Fast's Couplings give you *lowest cost per year* . . . because they usually outlast the equipment they connect. And Fast's Couplings give you the benefit of Koppers *free engineering service* . . . assuring you of the right coupling for any job and the right solutions to tough coupling problems.

Write today for full details to KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 224 Scott St., Baltimore 3, Maryland.

KOPPERS®

THE ORIGINAL

FAST'S Couplings

METAL PRODUCTS DIVISION • KOPPERS COMPANY, INC. • BALTIMORE, MD. This Koppers Division also supplies industry with American Hammered Industrial Piston and Sealing Rings, Koppers-Elex Electrostatic Precipitators, Aeromaster Fans and Gas Apparatus.

Engineered Products Sold with *Service*

KOPPERS COMPANY, INC., *Fast's Coupling Dept.*, 224 Scott St., Baltimore 3, Md.

Gentlemen: Send me a Fast's Catalog giving detailed descriptions, engineering drawings, capacity tables and photographs.

Name .....

Company .....

Address .....

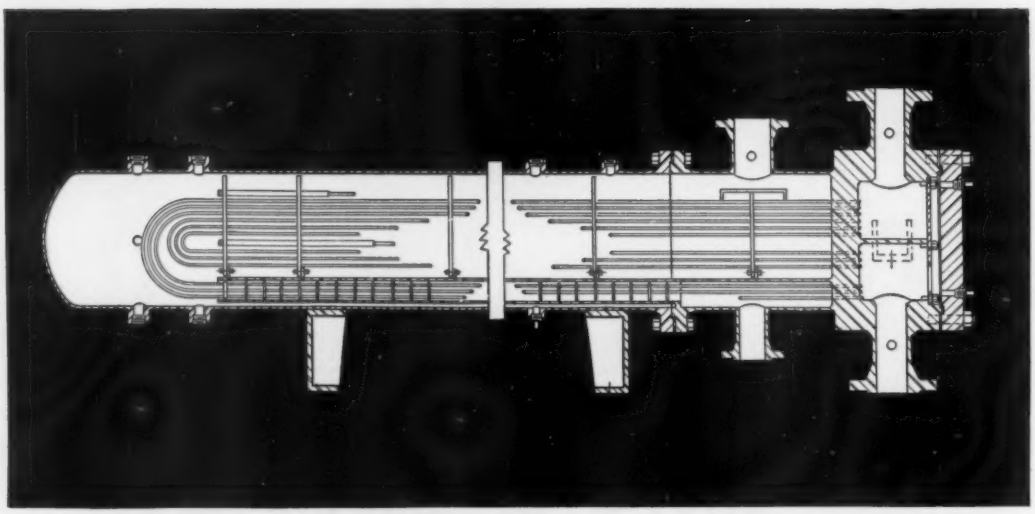
City ..... **Zone** ..... **State** .....

SUPERIOR FEEDWATER HEATERS

are BUILT to *YOUR* REQUIREMENTS

Superior's flexibility in the design of heads, shells, and tube bundles provides tailored units to meet every feedwater heating requirement. Any combination of desuperheating, condensing, or subcooling in a single heater.

Leak-proof pass partition sealing plates using pressure drop of feedwater to insure a positive seal. Controlled steam travel through heater by means of specially designed baffles minimizes tube erosion.



DESIGNED FOR MAXIMUM THERMAL EFFICIENCIES

The illustrated typical Superior feedwater heater incorporates the most modern features of design. The unit is one of a pair recently supplied a large user of feedwater heaters. The tube design pressure is 850 p.s.i.

The integral subcooling zone cools the drips to a temperature close to that of the incoming feedwater. This increases the thermal efficiency of the heater and reduces the flashing of the drips to the next lower heater, thereby minimizing the erosive effect on both the interconnecting piping and the tube bundle.

The pass partition plate in the head uses the pressure drop of the boiler feedwater through the tubes to prevent leakage between passes and thus increases the thermal efficiency.

Our Engineering Department invites your inquiry on any proposed application as a basis for a specific engineering recommendation. Write for catalog 6010.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
HEAT EXCHANGERS

The new Life-Line A motor
...the big step ahead by Westinghouse

Here it is . . . the new Life-Line® "A" motor. A new motor that steps ahead to lead the industry. A new motor that reflects the continuing engineering and manufacturing leadership of Westinghouse. A new motor that gives you . . .

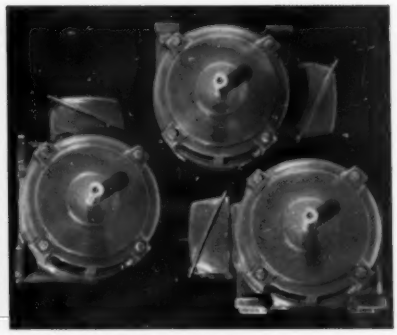
Greater protection	Lower maintenance costs
Greater application flexibility	Fewer motor outages
Smoother, quieter operation	Longer motor life

The new Life-Line "A" motor is still a step ahead of the industry. How? Through balanced design and proved performance. Look at the improved materials and advanced mechanical and electrical components—each one matched to its neighbor.

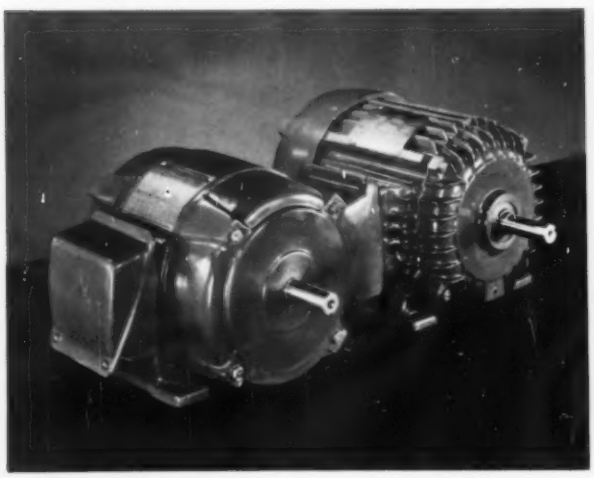
YOU CAN BE SURE...IF IT'S
Westinghouse

New 4-WAY SEAL, pre-lubricated bearing . . . another step ahead. A bearing with *two* protective seals on *each side.* Inner seals form labyrinth joints. Outer seals act as flingers. This bearing has the advantages of the original Life-Line sealed bearing—*plus extra protection.*

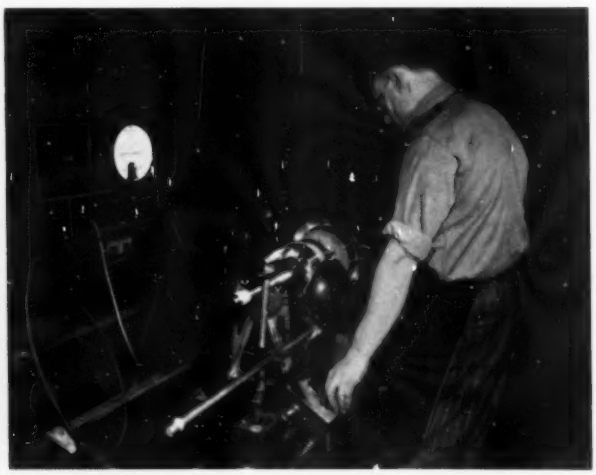
New FORTIFIED INSULATION . . . another step ahead. MYLAR*, a slot insulation with greater dielectric and mechanical strength. BONDAR, a wire insulation with more heat resistance. BONDITE, a stator insulation with greater strength to withstand destructive elements.



New PROTECTED HOUSING . . . another step ahead. Bracket openings are located in the under-quadrant for maximum protection. Brackets can be rotated for wall or ceiling mounting. Circumference of frame is *completely enclosed* so that it remains dripproof in *all* positions.



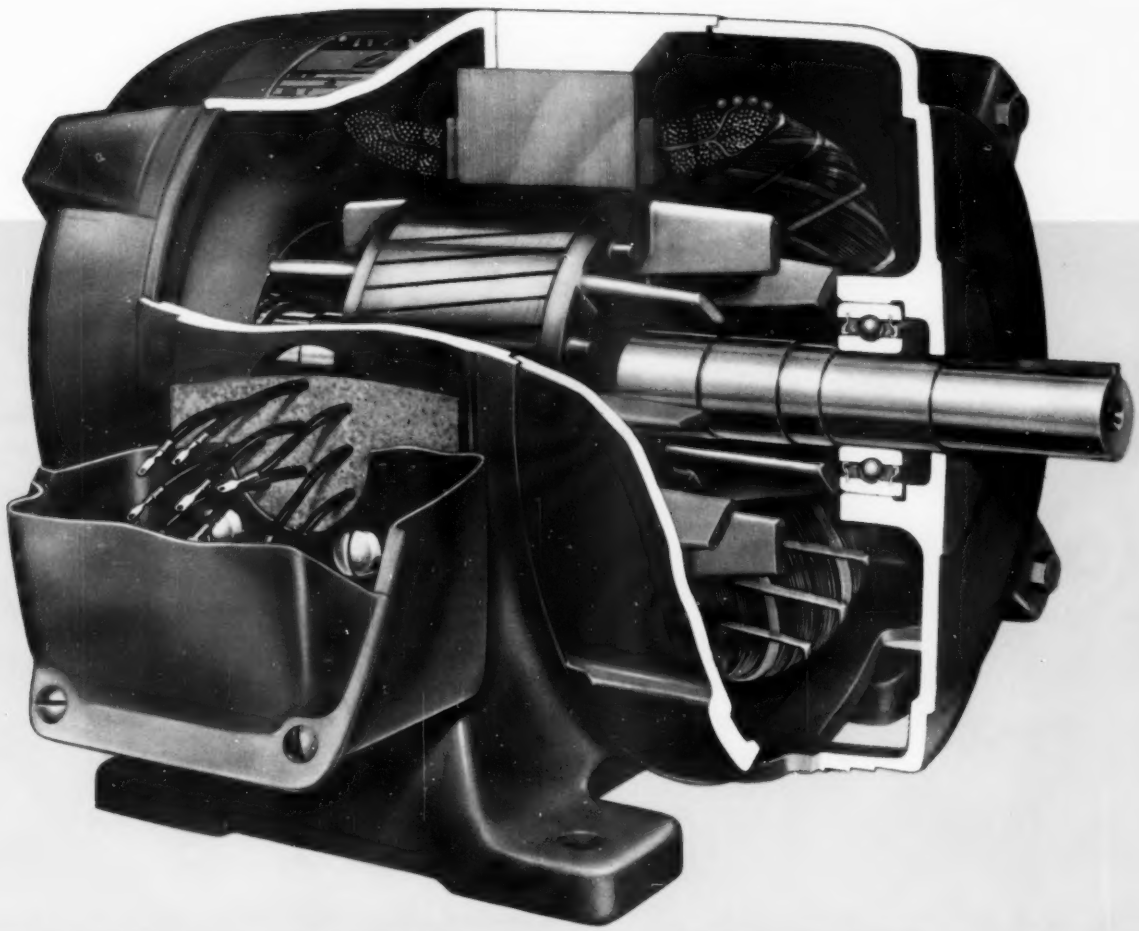
New ARMORIZED ENCLOSURE . . . another step ahead. The latest techniques in the casting art are utilized to fabricate more rugged housings that have greater application flexibility. Frame and ribbed feet are cast as a single unit for maximum rigidity. Wall sections are extra thick throughout.



New PRECISION MANUFACTURE . . . another step ahead. Each machining operation produces a new industry standard for concentricity. Improved rotor balance is attained through new precision tools. New rigid quality standards have been established for every component and the complete motor.

*Trademark for DuPont polyester film.

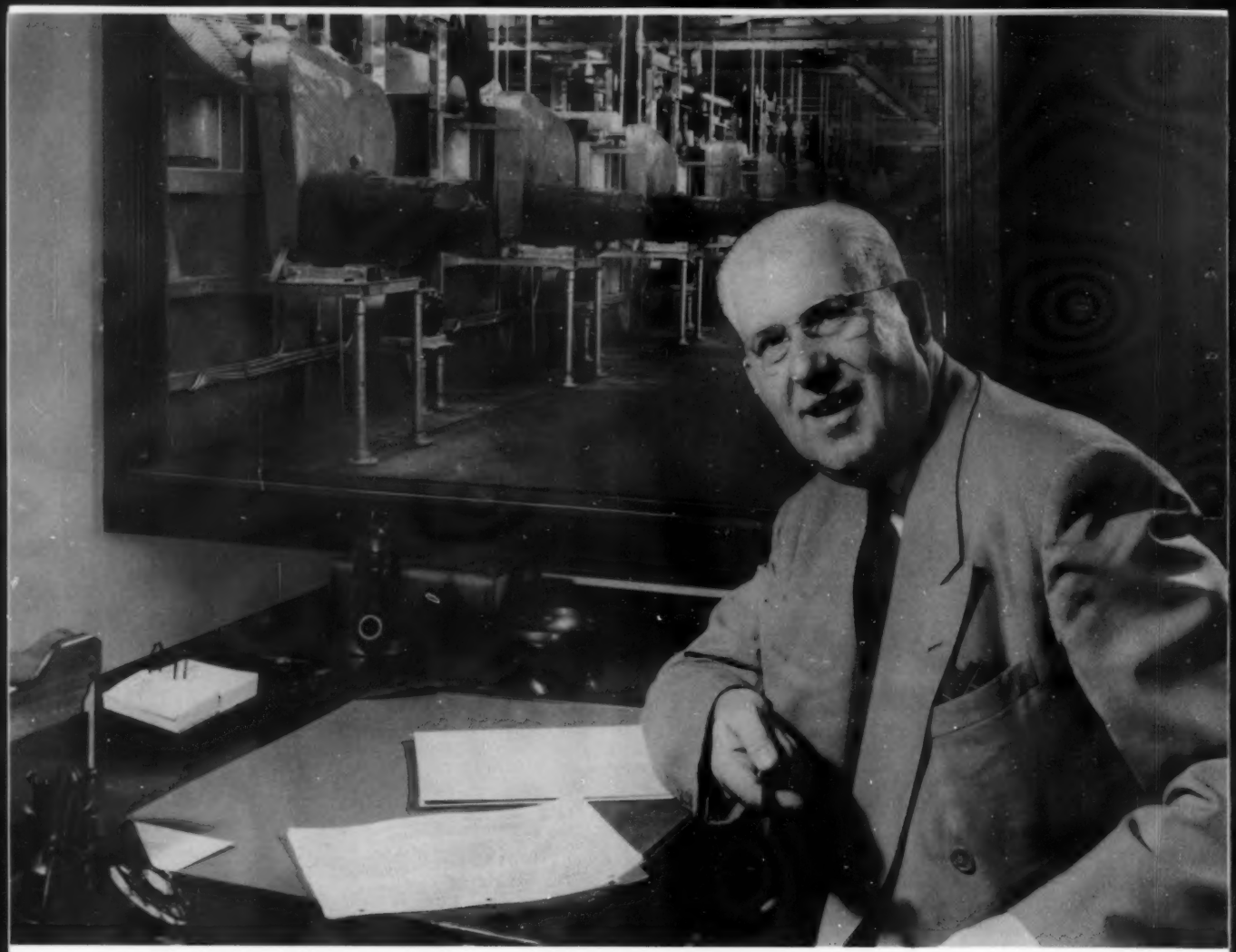
The new Life-Line A motor
...the big step ahead by Westinghouse



New? Yes, but not untried. The new Life-Line does not discard the past . . . it profits by it and builds upon it. Each component of the new Life-Line has been screened in the laboratory, then proved on production-line motors. You're not buying "theoretical" performance. The new Life-Line is a proved Life-Line.

GET THIS FREE BOOK

Here are all details on the new Life-Line "A" motor. Read about the new insulating materials—the new stator core—the new cooling methods—the new precision manufacturing techniques. Write for your copy of Booklet B-6154. Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pa.



"We Simplified Ordering, Speeded Servicing When We Specified *Life-Line* Gearmotors"

"We ended round-robin chases to various suppliers whenever speed-reduction equipment is needed. By using Life-Line® Gearmotors we place only one call to one manufacturer... Westinghouse. Our ordering procedure has been greatly simplified, for no other supplier need be contacted to complete our speed-reduction package.

"For servicing, too, we know just where to turn. Every component of Life-Line Gearmotors is made and serviced by Westinghouse. We've learned through experience that *one* call to Westinghouse brings prompt and expert attention for our entire drive equipment. Down time has been reduced which means a real saving for us."

Life-Line Gearmotors Mean Westinghouse Service

Every Life-Line Gearmotor is backed by a nationwide service organization, a ready supply of gearmotor parts, complete repair facilities conveniently located and a staff of field engineers ready for consultation on any of your drive problems.

Your local Westinghouse representative will be glad to give you full details. Call him at any time or write: Westinghouse Electric Corp., P.O. Box 868, Pittsburgh 30, Pa. J-21840-B

YOU CAN BE SURE... IF IT'S Westinghouse

WORTHINGTON DC-2 COMPRESSORS are installed in the Libbey-Owens-Ford Glass Company's Fiber-Glass plant in Parkersburg, West Virginia. They have five-step variable capacity controls enabling them to operate with a minimum power consumption.

Compressed air helps turn a single glass marble into 42 miles of textile filament!

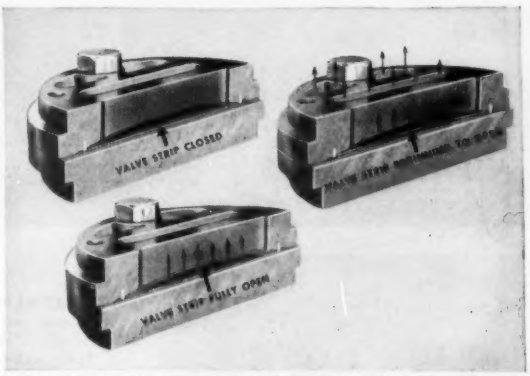
Libbey-Owens-Ford uses Worthington compressors in the manufacture of fiber glass

Daily, more than 40 million miles of filament, gathered into strands of fiber glass, twisted into yarns, and woven into industrial cloth, tape and other textile forms, are produced at the Libbey-Owens-Ford plant at Parkersburg, West Virginia.

The fiber glass filament is made by melting specially prepared glass marbles in small furnaces and drawing the glass through the minute apertures of a "bushing". Humidity is important in handling these continuous fibers of glass and compressed air is used to maintain accurate man-made weather. Compressed air is actually used in 22 important operations in making fiber glass in this ultra-modern factory.

Three Worthington DC-2 compressors, each with five-step capacity control, supply the air pressure required in these many delicate tasks.

Whatever your requirements for compressed air, Worthington builds compressors to meet them. Write us about your compressor problems. Worthington Corporation, Compressor Division, Section K.4.1, Buffalo, N.Y.



WORTHINGTON'S EXCLUSIVE FEATHER* VALVE lowers compressor fuel consumption. A series of thin flexible strips of ribbon steel lift and flex uniformly as shown. This lightest, tightest, most durable valve ever made is standard on all Worthington compressors. *Reg.U.S.Pat.Off.

K.4.1

WORTHINGTON

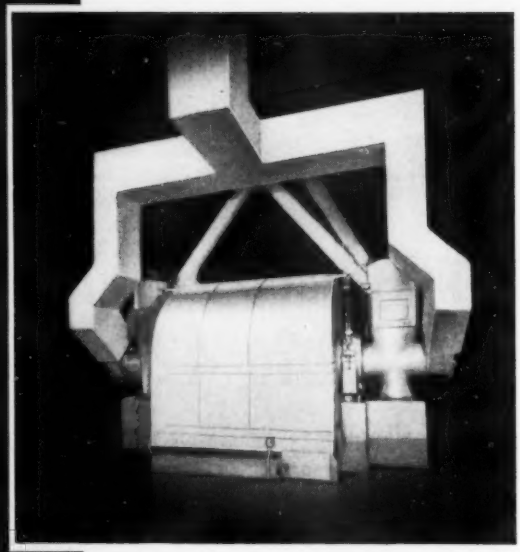
Only Worthington Compressors give you Feather Valve Performance

Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors

One source

... meets

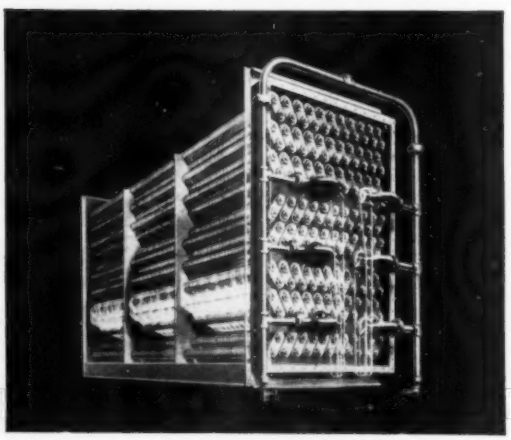
STEAM GENERATORS for every central station or industrial use, designed, engineered and built to meet your needs for the economies of higher temperatures and pressures over control ranges not previously obtainable.

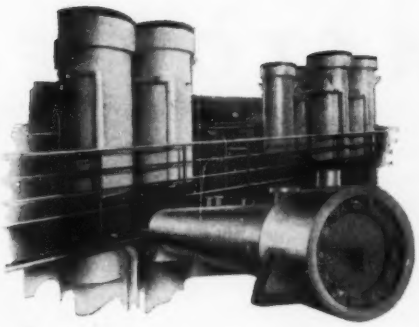


BALL MILL PULVERIZERS which grind hard, abrasive fuels to a constant fineness. Operating records show low maintenance, high availability of 99% or better.

SUPERHEATERS of the convection and radiant type, either singly or in combination. Superheat control over a wide load range is also offered as a means of positive and accurate control of final temperature.

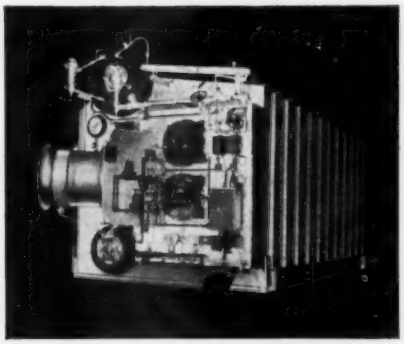
ECONOMIZERS of the cast-iron, extended-surface steel-tube type which are corrosion-resistant, impervious to soot fires, easily cleaned, and of unique, simple design. Bare tube construction also available.





PACKAGE STEAM GENERATORS in capacities of 10,000 to 30,000 lb. of steam per hr. Water-tube type, plant assembled, shipped ready to install. Design pressures of 250, 525, 825 psig provide operating pressures from 100 to 800 psig.

FEEDWATER HEATERS of the shell-and-tube type, as well as direct contact arrangements, are available. "Lockhead" closures have been built for pressures up to 3500 psi.

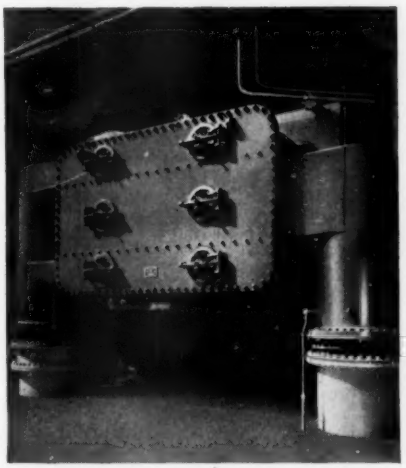


many of your steam plant needs

Only Foster Wheeler offers such a broad line of steam plant equipment engineered for increased efficiency through modernizatior

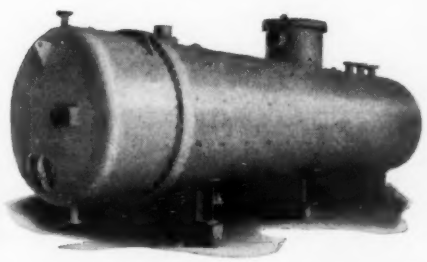
IN OVER 50 YEARS of service to the power industry, Foster Wheeler has pioneered the development of steam generators, fuel systems, condensers and cooling systems of the highest efficiency. Continuous research and engineering have created a background of technical experience, *as well as* an integrated line of equipment in which each individual product is designed to contribute to the efficiency of all.

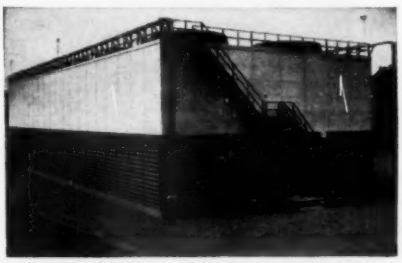
FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.



CONDENSERS to meet any conditions of headroom at any location. Our shops are fully equipped to supply units of 100,000 sq. ft. and larger.

EVAPORATORS for boiler feed make-up and of heat-transformer types in all sizes. Special types to handle raw and treated make-up to give the best thermal and descaling operation as well as producing pure vapor.





COOLING TOWERS custom-engineered to meet your requirements for greatest economy. Mechanical draft, counter-flow type. Provide minimum spray loss, flexibility to meet all weather conditions.

FOSTER WHEELER

FISHER® FACTORIES

MARSHALLTOWN, IOWA

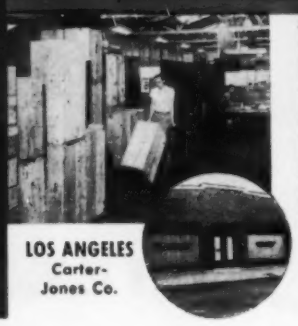
• Above—Factory No. 1. Over 255,000 sq. ft. of floor space. The industry's most modern plant. Here the world's largest production of pressure and liquid level control equipment is made possible by Fisher's unequalled research, design, engineering, testing and manufacturing facilities.

• At Left—Factory No. 2. Over 67,000 sq. ft. of floor space. A major unit in Fisher's continuing expansion program of increased facilities and production.

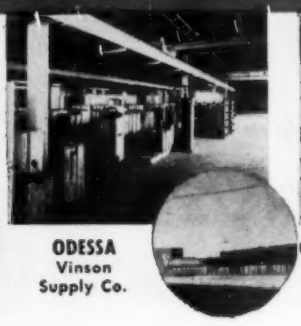
FISHER

- PRESSURE REGULATORS
- GAS REGULATORS
- LIQUID LEVEL CONTROLLERS
- DIAPHRAGM CONTROL VALVES
- PUMP GOVERNORS
- LEVER and FLOAT VALVES

A few typical Fisher Warehouse Stocks of new equipment and replacement parts are shown below.



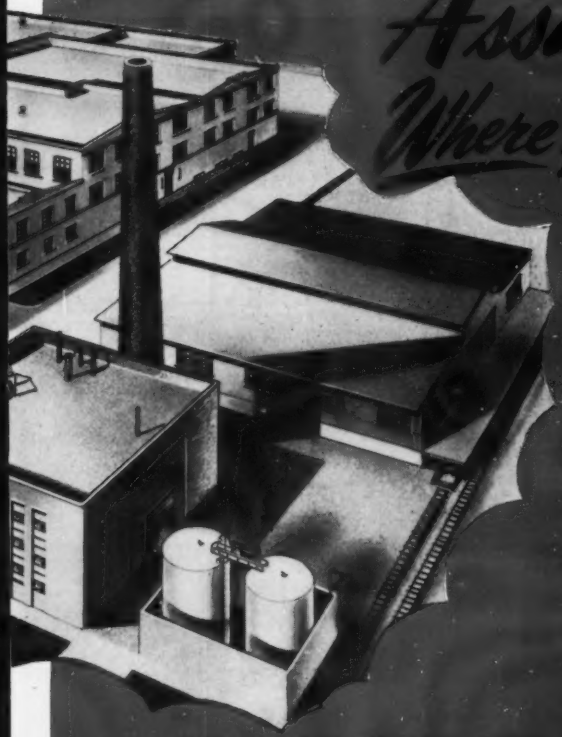
LOS ANGELES
Carter-Jones Co.



ODESSA
Vinson Supply Co.

CORPUS CHRISTI
Puffer-Sweiven Co.

AND FIELD STOCKS



Assure You Delivery

Where you want it! When you want it!

FISHER SERVICE DIRECTORY

ALBANY
Malcolm W. Black & Co.
* **AMARILLO**
Vinson Supply Co.
ATLANTA
Rittelmeyer & Co., Inc.
BALTIMORE
Rhodes Controls Co.
BIRMINGHAM
Jos. W. Eshelman & Co., Inc.
BOSTON (West Newton)
Wickersham, Petty & Co.
BUFFALO
W. J. Sommers Co.
* **CALGARY**
Barber Engineering & Supply Co.
CHARLOTTE
Robert E. Mason & Co.
CHICAGO
General Meters & Controls Co.
CINCINNATI
Harry T. Porter Co.
CLEVELAND
A. E. Ehrke & Co.
* **CORPUS CHRISTI**
Puffer-Sweiven Co.
* **DALLAS**
Vinson Supply Co.
* **DENVER**
Joy & Cox, Inc.
* **DETROIT**
DuBois-Webb Co.
HONOLULU
H. S. Gray Co.
* **HOUSTON**
Puffer-Sweiven Co.
INDIANAPOLIS
Acme Engineering Agency
KANSAS CITY
Sullivan-Mears Co.
* **LOS ANGELES**
Carter-Jones Company
LOUISVILLE
Allan K. Cook Co.
* **MARSHALLTOWN**
R. S. Stover Co.
MEMPHIS
Johnson & Scott
MILWAUKEE
Warren D. Ehrke & Co.
MINNEAPOLIS (Hopkins)
J. F. Schultz & Co.
* **MONTREAL**
Process & Steam Specialties, Inc.
MUSKEGON
DuBois-Webb Co.
NARBERTH, PA.
Clifford B. Ives & Co.
NASHVILLE
Johnson & Scott
* **NEW ORLEANS**
John H. Carter Co.
NEW YORK
Malcom W. Black & Co.
NORTH LITTLE ROCK
Johnson & Scott
* **ODESSA, TEXAS**
Vinson Supply Co.
PHOENIX
Cone & Wallace Co.
PITTSBURGH
W. A. Stoeltzing
* **PORTLAND, ORE.**
Richard H. Brown & Co.
RICHMOND
W. H. Kidd & Co.
* **SAN FRANCISCO**
George R. Friederich & Co.
SAN JUAN
F. A. Ortiz & Co.
SALT LAKE CITY
Williams, Gritton & Wilde
* **SEATTLE**
Barrett & Yost
* **SHREVEPORT**
John H. Carter Co.
* **SOUTH EDMONTON**
Barber Engineering & Supply Co.
ST. LOUIS
H. D. Hale & Co.
* **TORONTO**
George W. Snecroft Co., Ltd.
* **TULSA**
Vinson Supply Co.
VANCOUVER
Northern Columbia Process Equipment Co.
WICHITA
Sullivan-Mears Co.

* *Indicates Field Stocks.*

YOU SAY WHEN AND WHERE
AND WE'LL BE THERE!

You are always close to a source of supply of Fisher control valves, gas regulators, liquid level controllers and pressure regulators.

Whether your problem is one of existing equipment—or an entirely new control application—the Fisher country-wide net-work of 19 *strategically located field stocks* and 49 *representatives*—with over 200 Fisher Service Engineers—offers you immediate and convenient service on all your control requirements.

FISHER GOVERNOR COMPANY

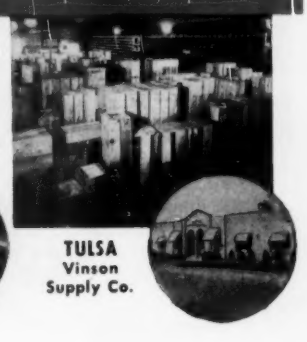
MARSHALLTOWN, IOWA

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

HOUSTON
Puffer-Sweiven Co.

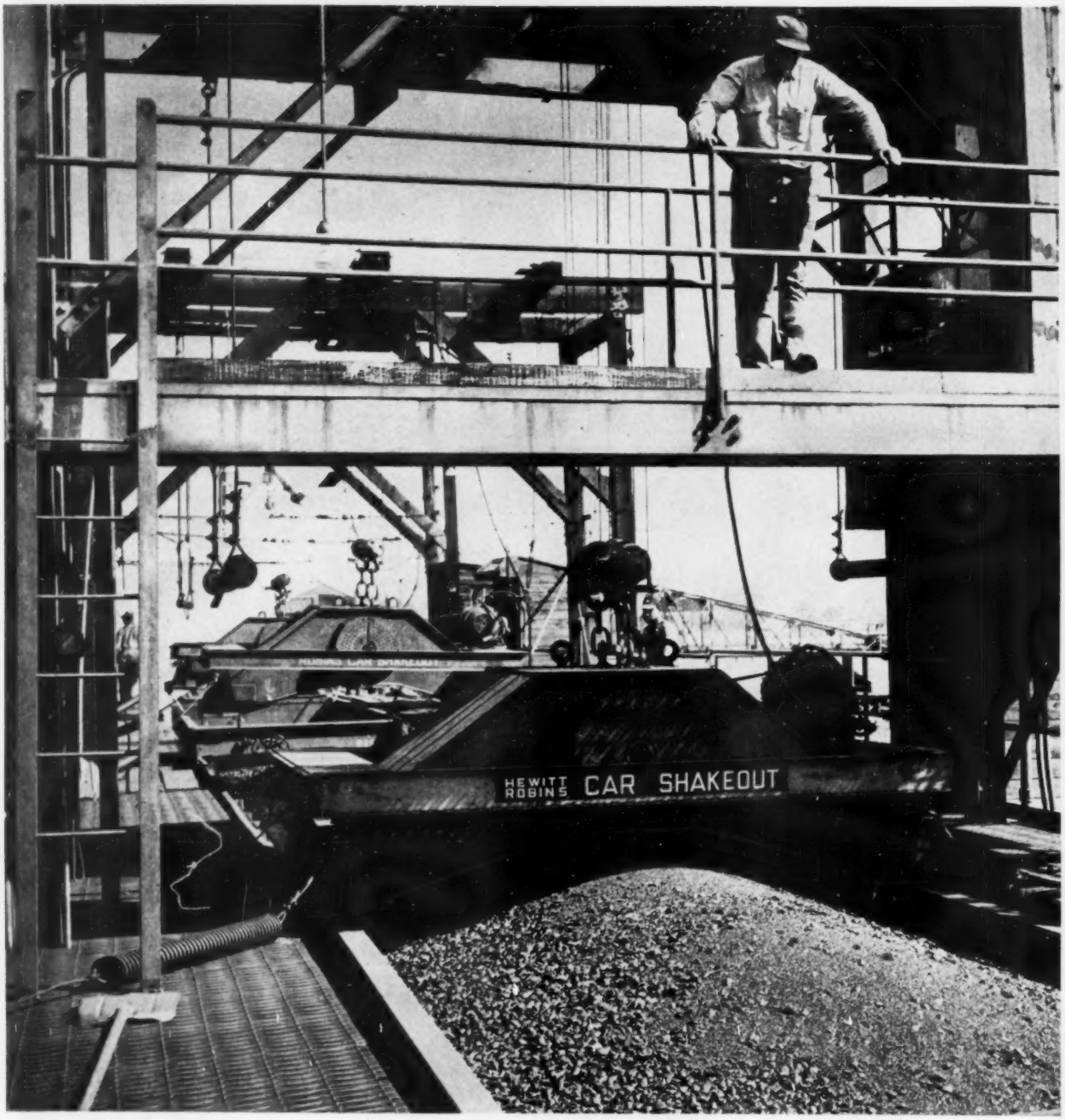
NEW ORLEANS
John H. Carter Co.

DALLAS
Vinson Supply Co.



TULSA
Vinson Supply Co.

Five HD Car Shakeouts



HEWITT-ROBINS

EXECUTIVE OFFICES, STAMFORD, CONNECTICUT

Unload Up To 2,600 TPH

22,070,523 Ton Total in 72 Months of Operation since 1946

CUSTOMER'S PERFORMANCE RECORD

EQUIPMENT: Five Hewitt-Robins HD (Heavy Duty) Car Shakeouts in line system.

LOCATION: Docks of the Rail to Water Transfer Company, Chicago, Illinois.

OPERATION: Unloading coal from hopper cars for transfer to Great Lakes' freighters.

PERFORMANCE: These five Hewitt-Robins HD Car Shakeouts unload from 1,900 to 2,300 tons of coal per hour (Tonnages handled are limited to the maximum capacity of other equipment in the complete coal handling system) . . . a total of over 75,000 hopper cars during the 1953 normal nine month operating season. Three Car Shakeout units started operations in 1946—two additional units were added to the line system in 1951—altogether they unloaded a total of 22,070,523 tons since 1946!

RESULTS: Total tonnages jumped from 1,349,310 tons in 1946 to 4,007,000 tons unloaded in 1953. Rail to Water Transfer Company reports the units . . . save time . . . save money . . . have generally paid for themselves in two seasons of operation.

ENGINEERING DATA

MODELS: 5-ton HD (Heavy Duty) . . . 3½ ton GS (General Service) . . . Both fit all hopper bottom cars in domestic service.

DUTY: GS Model generally recommended for 10 cars per day, HD Model up to 100 cars per day handling wet, compacted or partially frozen loads. (Capacity figures vary depending upon characteristics of material.)

SPECIFICATIONS: 5/32" stroke—1,500 vibrations per minute (easily adjustable for specific applications) . . . Motor platform supported on coil springs to protect motor from vibration . . . HD Model vibrating frame of welded construction throughout, stress relieved after welding . . . GS Model fabricated from rolled sections of riveted construction . . . Both models available with recommended companion twin-hook Car Shakeout Hoist.

Patent No. 2,504,789

Here is a partial list of

HEWITT-ROBINS PRODUCTS

that will help you cut handling costs and increase operating efficiency.

MACHINERY

- Belt Conveyors
- Belt & Bucket Elevators
- Car Shakeouts
- Conveyor Idlers
- Dewaterizers
- Mechanical Feeders
- Foundry Shakeouts
- Mine Conveyors
- Reclaiming Systems
- Screen Cloth
- Stackers & Trippers
- Vibrating Conveyors & Screens

INDUSTRIAL RUBBER PRODUCTS

BELTING:

- Conveyor
- Elevator
- Transmission

HOSE:

- Acid
- Air & Air Drill
- Barge Loading
- Dust Suction
- Fire
- Fuel Oil & Gasoline
- Gasoline Pump
- Mud Pump Suction
- Oil Suction & Discharge
- Propane-Butane
- Road Builders'
- Rotary Drilling
- Sand Blast
- Sand Suction
- Sea Loading
- Servall®, All-Service
- Steam
- Tank Car & Tank Truck
- Vacuum & Air Brake
- Water & Water Suction
- Welding, Twin-Weld®

•

For information and service on industrial rubber products, contact your Hewitt-Robins Industrial Supply Distributor. Through his complete stock of Hewitt-Robins Rubber Products, and his familiarity with local field conditions, he can fill your supply needs promptly and correctly. See Classified Phone Book for the Hewitt-Robins Industrial Supply Distributor serving your area.

1908

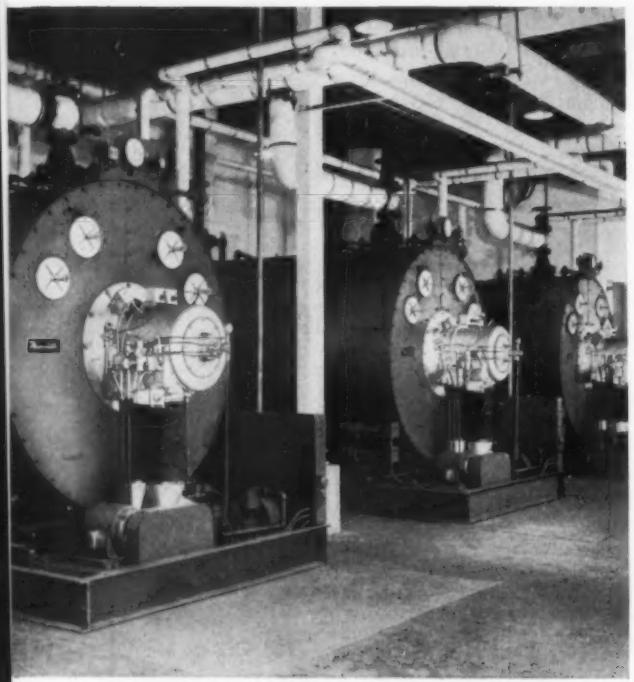
INCORPORATED

DOMESTIC DIVISIONS: Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam
FOREIGN SUBSIDIARIES: Hewitt-Robins (Canada) Ltd., Montreal • Hewitt-Robins Internationale, Paris, France • Robins Conveyors (S. A.) Ltd., Johannesburg • **EXPORT DEPARTMENT:** New York City.

New.. Powermaster®

exclusive....

Now . . . for the *first time* you can get packaged boiler units in the wide range of capacities from 15 to 500 HP, with *complete interchangeability of fuels* . . . light or heavy fuel oil—natural or manufactured gas—or combination gas and oil . . . and you get this cost-saving advantage *only* with *Powermaster* Packaged Automatic Boilers. Find out more about this new, wide-range service today from your *Powermaster* representative. He will help you with recommendations and suggestions for selecting the most economical units to supply steam or hot water requirements in any kind of service—industrial plants, institutions, public buildings, schools, laundries, apartment houses, hospitals, dairies, motels, and shopping centers.



- Complete Fuel Flexibility:
  Light or Heavy Oil, Any Gas or Combination Oil and Gas.
- Choice of:
  Air Atomizing VORIFLOW Oil Burner —Pre-Mix VORIFLOW Gas Burner— Combination VORIFLOW Oil and Gas Burner—All Designed and Built by O & S.
- Full-Range Modulation with VORIFLOW Combustion.
- All Middle-Range and Large Capacities.
- Selection of Automatic Operating and Safety Controls.
- Instant Change from Fuel to Fuel.

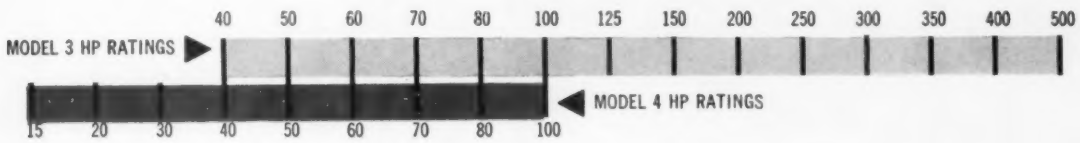
Model 3 *Powermaster*—Experienced-proved to be the standard of industry. These three 350 HP units are supplying process steam at pressures up to 200 psi.

Send for bulletins describing Model 3 and Model 4 *Powermaster* units.

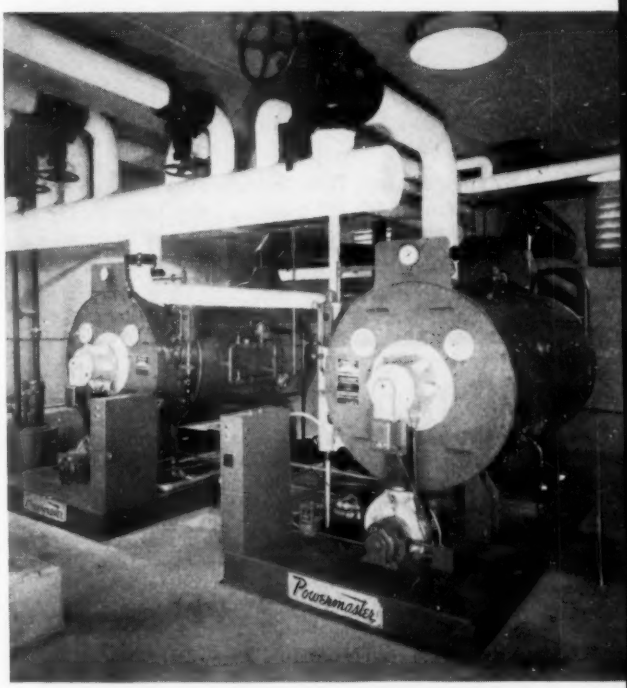
ORR & SEMBOWER, INC.
READING, PA.
BUILDING DEPENDABLE BOILERS SINCE 1885

. . a choice of 2 *Powermaster* Packaged Automatic Boilers to meet your specific operating requirements . . . to your best advantage.

for 15 to 250 psi. steam or hot water



- Choice of Fuels:
  Light Distillate—Natural Gas—Manufactured Gas—Combination Oil and Gas.
- Choice of:
  Mechanical Pressure Atomizing Oil Burner—Pre-Mix Gas Burner—Combination Oil and Gas Burner—All Designed and Built by O & S.
- On-Off and Low-Fire Start Burners.
- Small and Popular Middle-Range Capacities.
- Selection of Automatic Operating and Safety Controls.
- Quick Change from Fuel to Fuel.

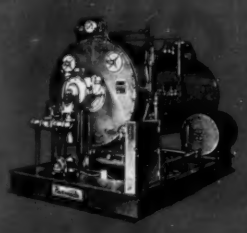


Model 4 *Powermaster*—Already service-proved in wide variety of successful applications. This installation of 40 HP units supplies 15 psi. steam for heating.

O&S

Powermaster®

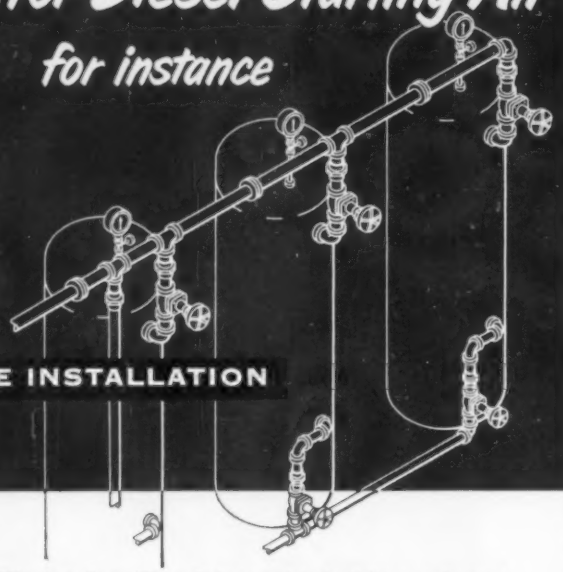
PACKAGED AUTOMATIC BOILERS



If It's a Hard-to-Hold Fluid, Here's Your Valve

...for Diesel Starting Air

for instance



THE INSTALLATION

By Higgins, Inc., New Orleans ship building and repair yard, famous for PT boats . . . now using Crane heavy-duty all-iron valves for 250 psi diesel starting air systems on passenger and truck ferries, fishing boats, etc.

VALVE SERVICE RATINGS

SUITABILITY:	100% Effective
FEATURES:	Lead faced disc
MAINTENANCE COST:	Rarely needs care
SERVICE LIFE:	Indefinite
OPERATING RESULT:	No loss of diesel starting air
AVAILABILITY:	Crane catalog item — No. 1504

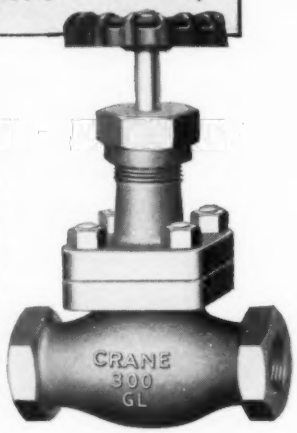
THE CASE HISTORY

By Higgins engineers' standards, marine diesel power is only as dependable as its starting equipment. Specifications are that a full charge be maintained in the starting air tanks overnight and longer. This, they found impossible with the conventional seating valves normally available for 250 psi working pressure.

But with Crane No. 1504 heavy-duty all-iron valves installed at the tanks, the problem was solved perfectly. These all-time favorites for dependable control of ammonia and other hard-to-hold fluids, are holding 250 psi starting air in the tanks indefinitely . . . and with valve dependability assured by Crane quality.

THE VALVE

Proved completely dependable in high-pressure ammonia, Crane No. 1504 all-iron globe valves are widely preferred for many air, oil, and gas services requiring the tightest seating, leak-proof body-bonnet joint, and extra-durable stem seal. Regularly supplied with lead face disc, or with steel seating for higher temperature and corrosive fluids. Sizes ¼ to 4 in.; flanged or screwed ends; also angle patterns. Ask your Crane Representative for Folder AD1977.

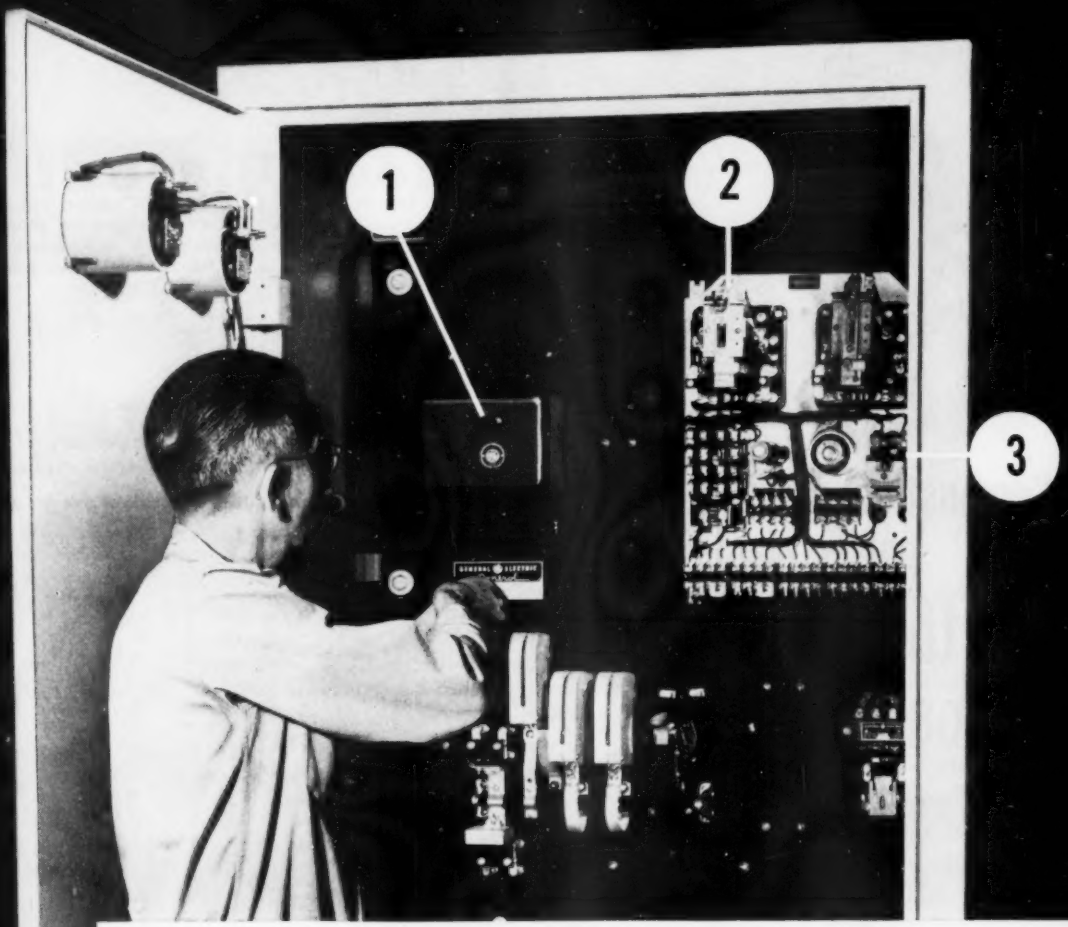


THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING



Only G.E. Gives You These 3 Features in Standard Synchronous Motor Control at No Extra Cost

1. GRADUATED SQUIRREL-CAGE PROTECTION Relay protects motor during stall or subsynchronous operation. Protects squirrel-cage winding against overheating.

2. PRECISION ANGLE SWITCHING Field application relay takes fullest advantage of motor's synchronizing ability—applies field at correct speed and most favorable angle between rotor and stator poles.

3. LOAD ANGLE FIELD REMOVAL Fastest field removal available assures long motor life. Power-factor relay removes field within first half slip cycle out of synchronization.

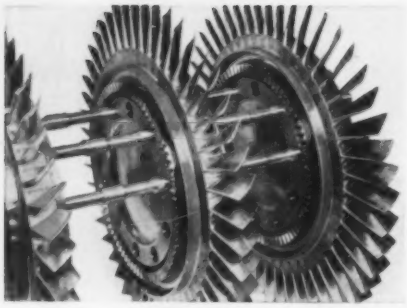
You get these and other big features in *standard* G-E synchronous motor control at no extra cost. Be sure to get complete details—contact your nearest G-E Apparatus Sales Office or use the convenient coupon to get our new 16-page desciptive bulletin.

Section D 780-3
General Electric Company
Schenectady, N. Y.

Please send me your new bulletin, GEA-5873 which gives complete information on G-E Synchronous Motor Control.

Name .....
Position .....
Company .....
Address .....

GENERAL ELECTRIC



The turbine rotor is a set of interlocking discs held together with Inconel "X" bolting. The forged Inconel "X" blades fit into pine-tree grooves machined axially on the discs. The blade contours provide for maximum conversion of heat energy into work; the use of Inconel "X" assures dependable performance under high temperature conditions.

Combustion gas turbine power plants—

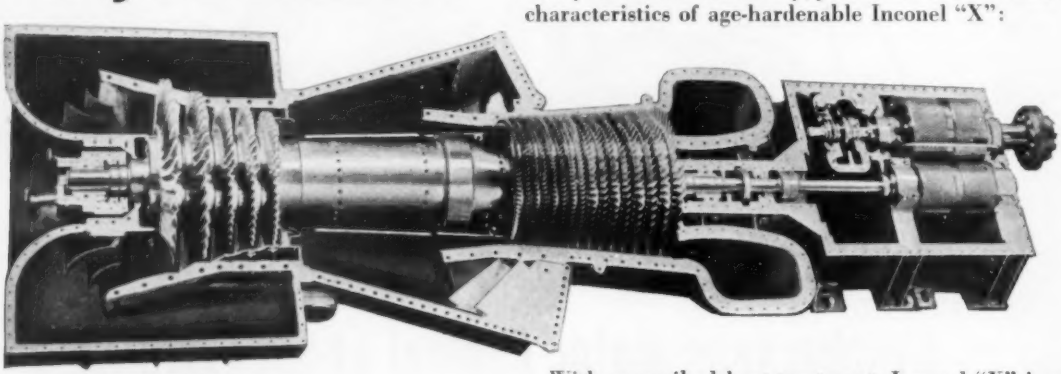
have they a place in your future?

The combustion gas turbine is past the experimental stage. It's a new source of power for mechanical drive applications.

Many problems, of course, had to be worked out before the new turbine got to where it is today. The problem of metal failure at high temperatures, for example, caused trouble time and again.

But now the WESTINGHOUSE ELECTRIC CORPORATION has a practical answer. This major turbine builder is using Inconel "X" for blading and high temperature bolting. Inconel "X" provides the longest periods of uninterrupted service at the lowest cost yet achieved.

If you want to know why, just look at some of the principal characteristics of age-hardenable Inconel "X":



Converts gaseous or liquid fuel directly into mechanical power. This Westinghouse 7000-hp gas turbine plant is of the simple open-cycle type. Its three major components, axial flow air compressor, combustion system and gas turbine, are contained in a single casing assembly. Rotor blades are forged from Inconel "X" bar stock. The bolts holding rotor discs together are also Inconel "X". (See photo above.)

With prescribed heat-treatment, Inconel "X" is one of the most useful alloys available for service at 1350° to 1500°F. It has good creep strength and excellent resistance to oxidation at these high temperatures.

Its stiffness, or modulus of elasticity, is about equal to that of alloy steels. Its resistance to impact is good, too. And it can be forged, fabricated and machined, can be welded by all the commonly used processes.

What's more, Westinghouse engineers have found Inconel "X" a good commercial quality material with little variation from melt to melt. That's because Inconel "X" is a standard alloy which Inco has produced steadily for a number of years.

Whether combustion gas turbine power plants figure in your immediate future or not, you'll do well to remember Inconel "X". It could very likely be the metal best suited to solve a high temperature problem in *your* plant. Don't hesitate to call on Inco's Technical Service Section for any information and help you want. There's no obligation, of course.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO TRADE MARK

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL • "KR"® MONEL
"S"® MONEL • INCONEL® • INCONEL "X"® • INCONEL "W"® • INCOLOY®
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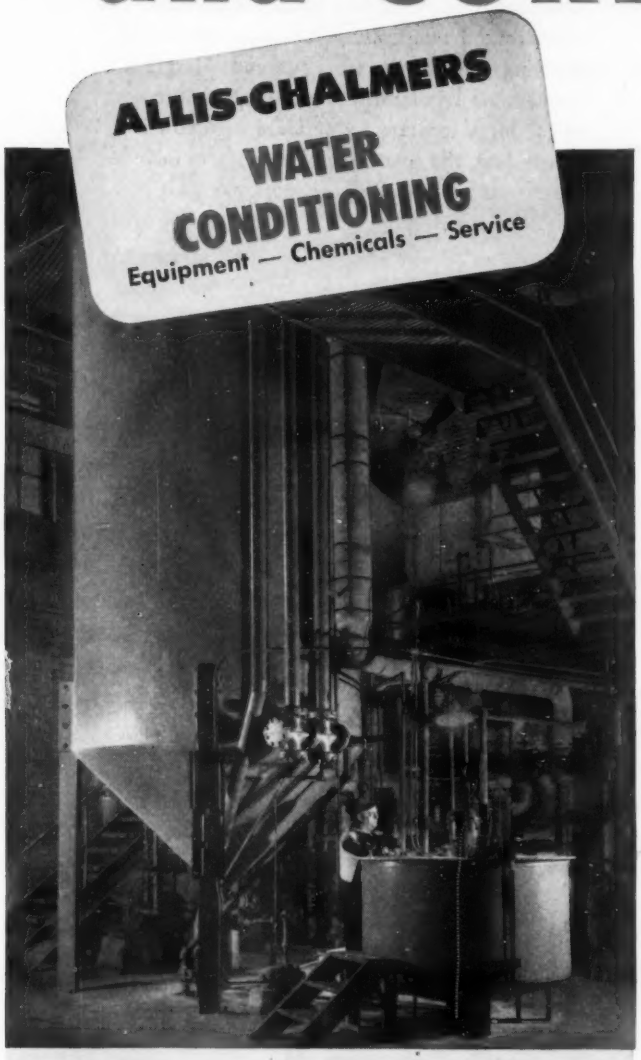
Gilbert Paper Co., Menasha, Wis.

Prevents SCALE and CORROSION



Equipment at Gilbert Paper Company includes hot process lime-soda softener and chemical feeder. For more information on this process, write for Bulletin 28B6611.

To prevent scale and corrosion in water used for steam generation, Gilbert Paper Company removes mineral constituents and dissolved gases by using Allis-Chalmers hot process lime-soda water conditioning. As a result, boiler outages and maintenance are greatly reduced. The process is the same as that used in many installations for process water.

What Hot Process Lime-Soda System Does

The complete installation heats water to the boiling point for removal of corrosive gases. Proportioning equipment introduces chemical reagents continuously and precisely into the water being treated. Precipitate induced by the thermo-chemical reaction is coagulated, settled, and separated from the water, which is then ready for use in steam generation. Apparatus includes a chemical solution tank, chemical proportioner and pump, reaction and sedimentation tank, pressure filters and accessories.

How You Can Solve Your Water Problems

If you have a water problem, you'll find Allis-Chalmers complete service a useful addition to your power or process water operations. Many years of experience plus a complete line of equipment and chemicals enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

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Here's real economy in temperature control.

Because Spence Temperature Regulators are designed to limit heater steam pressures to an adjustable maximum, the need for a separate reducing valve is completely eliminated.

The Spence Regulator takes steam directly from the boiler or high pressure line, reduces the pressure and regulates the flow as required to maintain a constant temperature output from the heater.

This means one relatively small combination pressure and temperature regulator replaces a reducing valve of the same size and a larger temperature regulator. Practically the entire cost of the large separate temperature regulator is saved. And, the total saving would also include the cost of a 3-valve by-pass along with all labor for installation.

This design feature is just one of the reasons for the thousands of Spence installations throughout American industry. *For details of other important design features, write for Bulletin T50.*

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TYPE ET150
Temperature
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WALDEN, NEW YORK

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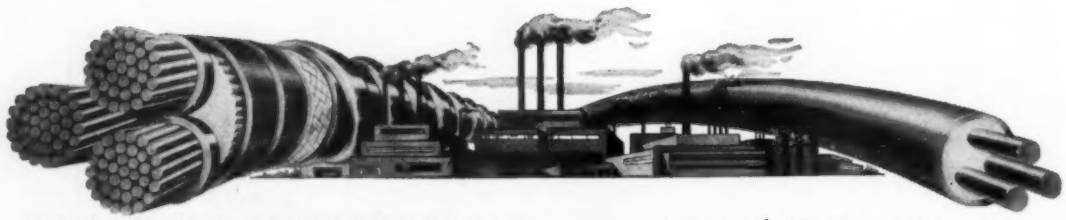

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The famous Power Twins combine lower installed costs with unique adaptability. They are ideal for electrical wiring without conduit in close areas and under, down and around beams and pillars...where power needs vary... where plant layout presents difficulties.

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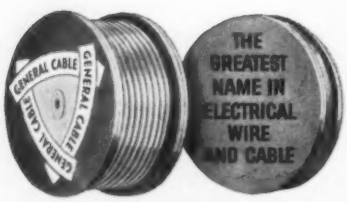
Safety m.i. Wiring System, all mineral insulated and exclusive with General Cable, is ideal for all applications up to 600 v. where heat, vapors, moisture, aging are of particular concern. Lower installed cost! Small diameter saves space! Trains easily for neat, compact installation. Investigate this popular combination before you buy. They can save you time and money.



BARE, WEATHERPROOF, INSULATED WIRES and CABLES FOR EVERY ELECTRICAL PURPOSE

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Carl Gustaf Patrik DeLaval

NOT LONG AGO leaders of business, industry and engineering gathered in the Hotel Pierre, New York, under the auspices of American Newcomen, to honor the memory of a great Swedish engineer—Carl Gustaf Patrik DeLaval. POWER welcomes this occasion to pay personal tribute to the man who pioneered in steam turbines, pressures up to 3400 psi and "super" speeds.

The dates of these achievements are impressive. By 1877, DeLaval was running a cream separator at 12,000 rpm. His notebook shows turbine sketches dated as early as 1876. By 1886 he had sketched the expanding steam nozzle, a brilliant and basic advance, and had already computed that the steam could leave such a nozzle with velocities as high as 4000 ft per sec. By 1890, he had built and tested a steam turbine far more efficient than any steam engine of the day.

By 1889, he had found a way to cut turbine rim speed in half by velocity compounding—putting two rows of blades on a single wheel.

DeLaval was that too-rare combination of a first-class education with practical experience, sound technical logic, a brilliant imagination and pioneer courage. He dared to attack problems head on—and knew how.

He was always quick to sense the essence of a problem and the nature of a sound solution. Thus he saw right at the start, that very high speed is an essential characteristic of an efficient single-expansion impulse turbine. And when his unprecedented turbine speed led to excessive vibration he sensed at once that a thicker shaft would be no cure. Instead, he made the shaft thin and springy so that the whirling mass could find its own natural center of rotation—a remarkable example of creative engineering.

Since his turbines, by their very nature, had to run far faster than the electrical generators and ships' propellers they drove, DeLaval conceived and built the prototype of today's double helical reduction gears.

In 1893, he shipped a small gear-coupled turbine-generator for exhibition at Chicago's Worlds Fair. The electricity delivered by this unit is believed to be the first ever produced in the United States by turbine drive. The unit is still in working order.

In the same year, four years ahead of Sir Charles Parsons' famous demonstration of the turbine drive in *USS Turbinia*, DeLaval had driven a small steamer by turbine. Amazingly (it was over 60 years ago) this turbine ran at 16,000 rpm, driving a 330-rpm propeller through a double-reduction gear—a speed ratio of 48 to 1.

Other technical achievements by this Swedish genius included improvements in the Bessemer converter for steel manufacture, a new way to galvanize iron plates, a cyclone furnace for the chemical processing of powered materials and improvements in air impellers. And, of course, DeLaval's name is outstanding among the pioneers in centrifugal separation.

But power engineers will remember him best as a pioneer in steam-turbine development, superpressures, and high-speed helical reduction gearing—and, above all, as the ardent apostle of super-speed.

DeLaval was born May 9, 1845 in Blasenborgs, Sweden. By the age of 30, already equipped with an engineering degree and a PhD degree in chemistry, he was also an experienced constructor, chemist, factory builder, industrialist and inventor. He lived to see his work take important shape in the 20th century. DeLaval died in 1913.

Now! . . .

An INTERRUPTING RATING in EXCESS of 100,000 AMPERES *for every set of fuse clips in your plant* . . . simply by installing FUSETRON *dual-element* FUSES

The Biggest Electrical Protection NEWS Since BUSS invented the FUSETRON Dual-Element FUSE

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

In 1947 tests made by the Electrical Testing Laboratories of New York, showed that on a circuit set to deliver 50,000 amperes, FUSETRON fuses in all tests cleared the circuit safely.

50,000 amp. Interrupting Capacity in 1947
becomes
100,000 amp. Interrupting Capacity Today

After years of intensive development work on FUSETRON fuses new tests were conducted under conditions that simulated the most severe field conditions and these tests were witnessed and verified by the Electrical Testing Laboratories of New York.

On circuits set to deliver in excess of 100,000 amperes, 30 to 600 ampere, 250 and 600 volt FUSETRON dual-element Fuses on each and every test cleared the circuit without belching flame or venting hot gases and with comparatively little noise.

Oscillograms of these tests interpreted by the Electrical Testing Laboratories, showed that the total available amperes including the direct current component, reached values as great as 165,000 peak amperes on 240 volt tests and as high as 212,000 peak amperes on the 535 volt tests.

This indicates that an interrupting rating of 100,000 amperes for FUSETRON dual-element fuses is a conservative one.

No interference with time-lag

In the development work to increase interrupting capacity in FUSETRON fuses it was kept in mind that the time-current characteristic must be maintained. Time-lag is of utmost importance to give proper motor and electrical protection and to eliminate needless blowing of fuses.

Remarkable results have been achieved. Interrupting capacity has been greatly increased while the time-current characteristic of FUSETRON fuses has in no way been disturbed.

Play Safe – install Fusetron Fuses throughout the entire electrical system!

Think!...

ALL THIS ADDED SAFETY *without changing a panelboard or switch...plus* 10 Point Protection of FUSETRON *dual-element* FUSES!

Maximum Safety

With FUSETRON Fuses there is no cascading of interrupting rating — no places where an excessive fault current might cause serious damage. Every FUSETRON fuse has an interrupting rating in excess of 100,000 amperes.

You don't have to worry about selecting chosen spots in which to *pay extra* for "safe" equipment. Wherever a FUSETRON fuse is installed you have safety as sure and dependable as you can buy — no matter what you pay.

No Maintenance Costs

When FUSETRON fuses have once been installed properly you can forget about them. They need no periodic inspections to see if they will operate safely.

Dust, fumes, corrosion or age cannot prevent a FUSETRON fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

With FUSETRON fuses — you get safety — without one cent spent for inspection or maintenance costs.

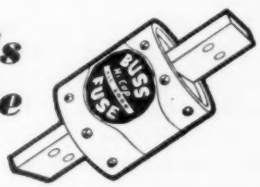
No Recalibration Costs

When a FUSETRON fuse does blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse that has been CALIBRATED AT THE FACTORY BY ENGINEERS— a fuse that is as safe and dependable as the one that blew.

PLUS 10 POINT Protection with FUSETRON dual-element FUSES

1 Protect against short-circuits. **2** Protect against needless blows caused by harmless overloads. **3** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **4** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5** Protect motors against burnout from overloading. **6** Protect motors against burnout due to single phasing. **7** Give DOUBLE burnout protection to large motors — without extra cost. **8** Make protection of small motors simple and inexpensive. **9** Protect against waste of space and money — permit use of proper size switches and panels. **10** Protect coils, transformers and solenoids against burnout.

for SAFE PROTECTION on loads above 600 and up to 5000 Ampere install BUSS Hi-Cap FUSES



Tests have shown that BUSS Hi-Cap fuses have unlimited interrupting capacity on circuits of 600 volts or less.

They are designed to give protection against dangerous overloads as well as high fault currents — yet their speed of operation on heavy shorts limits currents to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

When coordinated properly with FUSETRON dual-element fuses they will not open ahead of the fuses nearest to the fault. Thus trouble is isolated to the part of the circuit in which the fault occurs.

Added SAFETY on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of a bad fault.

ACTION THAT SAVES YOU MONEY

By passing the word along that all purchase and stock records should call for FUSETRON fuses on loads up to 600 amps—and BUSS Hi-Cap fuses on loads above that — you get action that begets money saving.

For blowing time charts or more information on FUSETRON Fuses and BUSS Hi-Cap Fuses write for Bulletins FIS and HCS.

Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo. Division McGraw Electric Company

Your copy is ready

...PIPING FOR PERMANENCE

The nature of piping problems in heating and plumbing systems, and the methods by which they can be solved, are discussed in detail in this 32-page Bulletin.

Prepared by our Engineering Service Department, this Bulletin is based on the information we have gathered from analysing complete data on thousands of piping installations of every type, under all kinds of conditions. This pool of experience has been condensed between covers in a clear, easily followed story to help you realize greater piping economy in your installations.

The bulletin also includes a roundup of wrought iron pipe installations from every part of the country and presents practical evidence of the results obtained from the use of the material. These past service records are providing leading engineers everywhere with a practical guide for today's selection.

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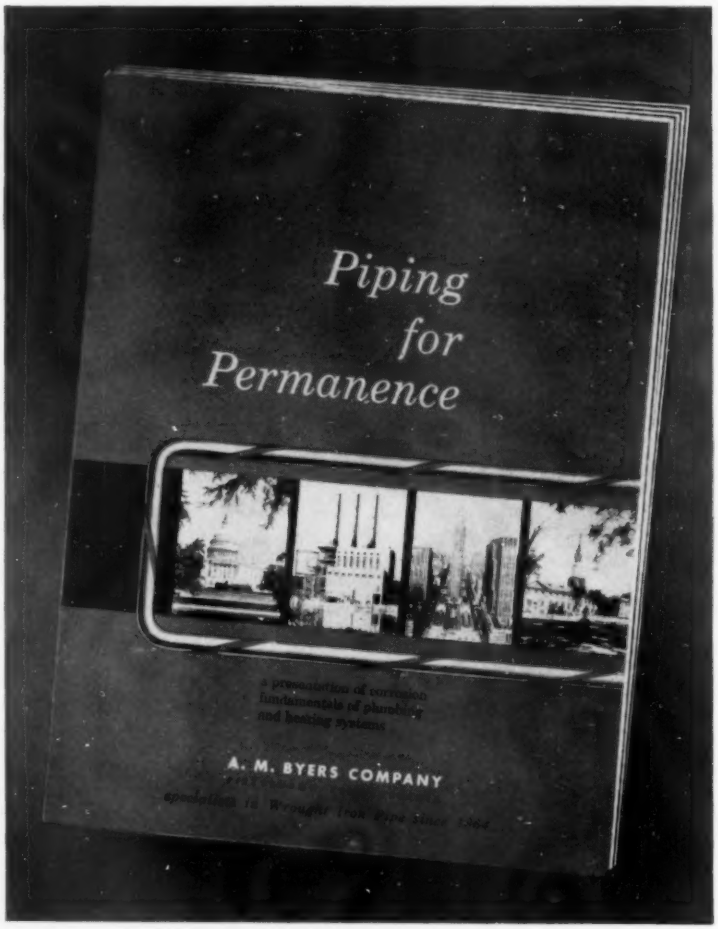

You'll find information on:

Requisites of a piping system—brief review of piping material properties essential to long-life, economical service.

Building-piping systems—definition of individual services; brief discussion of conditions that threaten service life in plumbing and heating systems and solutions; fundamentals of design and installation that may be used to reduce the rate and severity of corrosion.

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How Byers can help you—available data on piping installations to solve individual problems; how you can benefit from the records of our Engineering Service Department.

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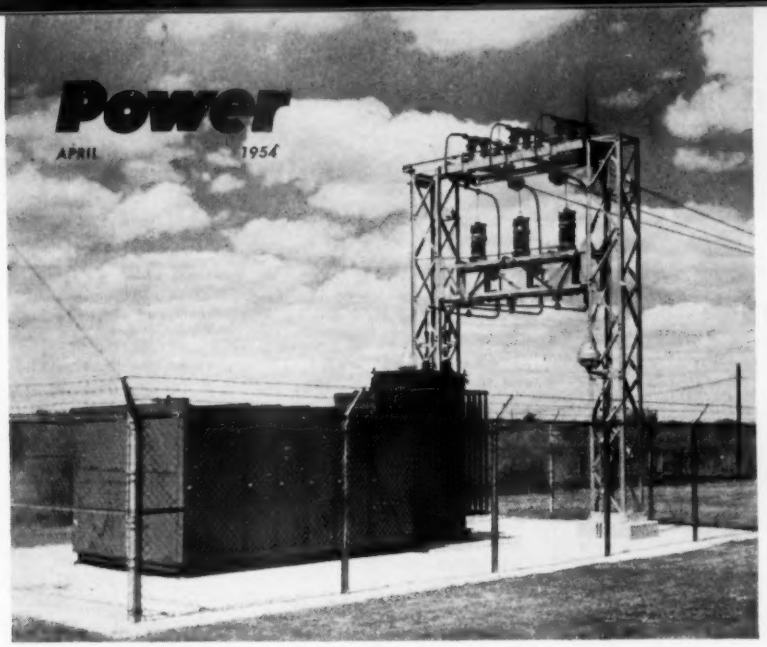
CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



Timely Facts on Utility Rates and Plant Loading To Help You . . .

. . . Trim Cost of Electrical Power

• Dig into the makeup of your electrical bill for a better understanding of demand, energy, load factor, pf, off-peak buying, fuel clauses, discounts. Then analyze the economics of owning the high-voltage primary substation

• With billing fundamentals behind you study plant load, looking for ways to smooth down demand peaks, reduce energy consumption, improve over-all pf. Then check if rate schedule you are now using is the one best suited.

All too often the power man, hard set on tracking down plant costs and tightening up on dollar leaks, simply overlooks the hidden potential savings in the monthly electrical bill. Sizable economies can often be shown by simply tabulating character of plant load and seeing if demand can be eased by load shifting. Pf improvement is still a strong possible dollar-saver, especially where a kva rate is used. Often a capacitor investment will pay for itself within the year. Consider all billing factors, noting that demand, energy and pf generally offer biggest savings for large and small plants

By H CARL BAUMAN, *Assistant Head of Utilities Div, Chemical Construction Corp*

More on next page ▶

After mastering rate schedules ...

Typical Industrial Rate Schedule

Demand charge for service at secondary voltage

$3.50 per kw	first 10 kw demand
2.50 per kw	next 40 kw demand
2.25 per kw	next 50 kw demand
2.00 per kw	next 100 kw demand
1.70 per kw	all additional kw demand

Energy charge

3.50¢ per kwhr	first 2000 kwhr
2.50¢ per kwhr	next 3000 kwhr
1.50¢ per kwhr	next 15,000 kwhr
1.30¢ per kwhr	next 30,000 kwhr
1.15¢ per kwhr	next 50,000 kwhr
1.05¢ per kwhr	next 100,000 kwhr
0.97¢ per kwhr	all additional kwhr

Discounts: Primary voltage discount $0.20 per kw of demand. Prompt-payment discount is 5% if paid within discount period.

Minimum bill: The demand charge, but for not less than 5 kw when secondary-voltage service is used, nor less than 25 kw when primary-voltage service is used.

Billing demand: The maximum 15-minute measured demand in the month subject to power-factor adjustment, but not less than 5 kw for secondary service, nor less than 25 kw for primary service. A fraction of a kw, if less than 0.5, will be dropped; if 0.5 kw or more, it will be billed as 0.5 kw.

Power-factor adjustment: When customer's average power factor is less than 80%, the demand, as determined above, shall be adjusted by multiplying it by 80% and dividing the product thus obtained by the average power factor in percent.

Standby or auxiliary service: Such service rendered under this rate schedule is subject to the requirement that the billing demand shall be not less than the highest demand previously established, nor less than the contract demand.

FIXED CHARGES in any rate schedule are included in demand section while most variable charges come under energy billing

► TOTAL COSTS in any electrical bill may be divided into two broad classifications: *Fixed charges* and *variable charges*. Fixed charges cover all generally predictable costs, such as depreciation, interest and insurance plus capital investments. In the latter group we have land, buildings, and equipment for generation, transmission, distribution, generally depreciated in 20 to 35 years. Once the capital investment is made and a definite depreciation time set, the charges hold about constant over the period.

Rate Schedule. Study any rate schedule, sample, *left*, and you will quickly spot these two characteristic parts. Fixed charges are generally covered by the demand charge. The variable charges come under the energy charge section.

Load factor is another important item. A plant, working an 8-hr day with a steady 1000-kw load, ties up as much generating, transmitting, distributing equipment as plant operating 24-hr around the clock at the same kw load. For the first plant, load factor is about 33%, while for the second, theoretical load factor is 100%. So rates are constructed to level out such situations, giving the higher load-factor user a more attractive plan.

Power factor should not be overlooked. Consider the plant pulling 1000 kw at 0.8 pf—meaning that 1250 kva must be supplied by the utility. A second plant draws the same 1000 kw demand, but it's at unity pf, requiring the utility to supply only 1000 kva. The 0.8 pf customer made it necessary for the power company to provide 25% additional in generation and distribution facilities to serve him with an amount of useful electricity equal to the second customer's. That's why the rate is so constructed to provide a saving for the high pf user.

Off-peak loads are a sizable consideration. Since most people work during daylight hours this period represents the greatest load on the utilities facilities. During working hours commercial, industrial and domestic loads coincide and peak sharply at beginning and end of this period. Often an industrial plant aims to operate some part of its capacity between 6 pm and 8 am, thus getting a better rate.

Voltage and Fuel. In a well-constructed rate, other factors must be taken into consideration. For instance, most users are supplied at voltages such as 120/208 or 440, directly usable in plant equipment. In such cases the power

Load character survey helps spot ways to lower demand

	Average Loading					Peak Loading					Total
Equipment	Hp	Eff, %	Running hr	Hr	Kwhr	Hp	Eff, %	Running hr	Hr	Kwhr	kwhr
Boiler-feed pump	80	82	6-9 am, 10 am-6 pm	11	800	95	84	9-10 am	1	85	885
I-d fan	42	80	8-9 am, 10 am-6 pm	11	430	50	81	9-10 am	1	46	476
Plant water pump	135	83	6-10 am, 12-6 pm	10	1210	150	85	10-12 am	2	264	1474
Water-storage pump						75	82	11-12 am	1	68	68
Hammer mill	45	75	8-9 am, 1-5 pm	5	224	60	76	9-12 am	3	177	401
Rock crusher	175	78	8-9 am, 1-5 pm	5	836	200	80	9-12 am	3	560	1396
Unloading derrick						70	78	8 - 9 am	1	67	67
Total					3500					1267	4767

CLOSE ANALYSIS of your plant demand is the first practical way of ferreting out ways of reducing the monthly bill. Start by making a complete study of load equipment, when and how it's used. You'll come up with a table similar to one shown here. Results are generally close enough if only the largest motors are considered. With chart in hand see if there is any practical way to decrease demand either by spreading starting periods for major motors or by swinging some load from high peak periods to dollar-saving off-peak hours.

...Analyze plant load for ways to decrease pf, demand, energy charges

company furnishes all transformation and switching necessary to convert from transmission and distribution voltages to voltage required at load.

Often the large user finds it necessary or expedient to purchase power at some higher voltage, say 4160, 13,800 or higher. Customer then furnishes necessary transformers to convert power at the higher voltage to voltages useful at his plant. When the customer buys and installs such equipment, he is in effect sharing part of the utility's fixed-charges burden. He is entitled to and generally gets some discount to cover his own fixed charges on this added investment.

There are still many rate schedules that provide for prompt-payment and other special discounts. Fuel cost is an important variable that affects the rate energy bracket. Total fixed charges are about 13 to 18% of the total cost of producing power, while fuel cost generally is between 30 and 60% of production cost. Any change in price, paid for fuel by the utility, affects production costs greater than any other factor.

Customer Classifications. No one rate can consider all these factors for all classes of customers. Rates, therefore, generally fall into following customer classifications: (1) domestic, residential and religious (2) commercial (3) small industry (4) large industry (5) municipal (6) special.

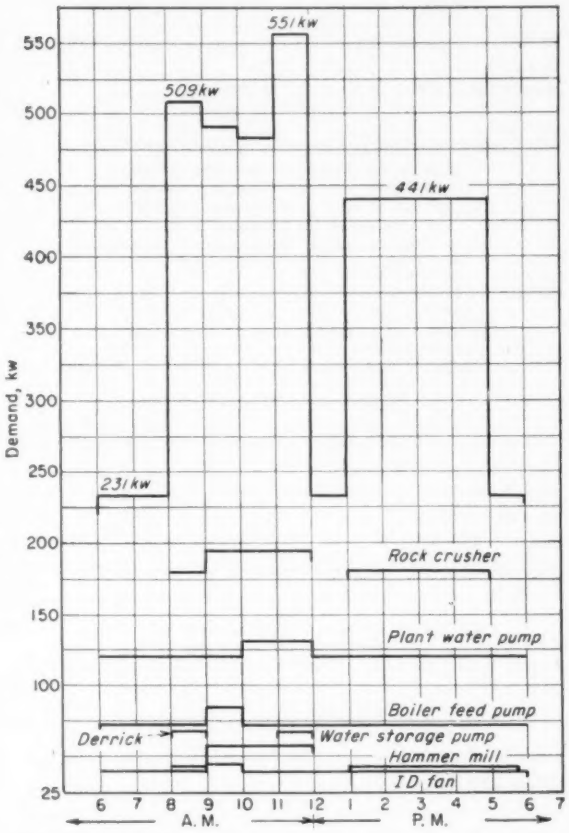
Looking for Savings. Above are the rate-structure ingredients. How can this knowledge be put to use in yielding dollar savings at your plant? Most important ingredients dollar-wise are demand, energy and power factor. And the first place to look for savings is in the demand.

So start with a complete study of plant load equipment. Sample table is shown on facing page. Such a tabulation indicates the load magnitude, while telling how and when demand is established. Reasonable results are obtained if only the largest plant motors are considered.

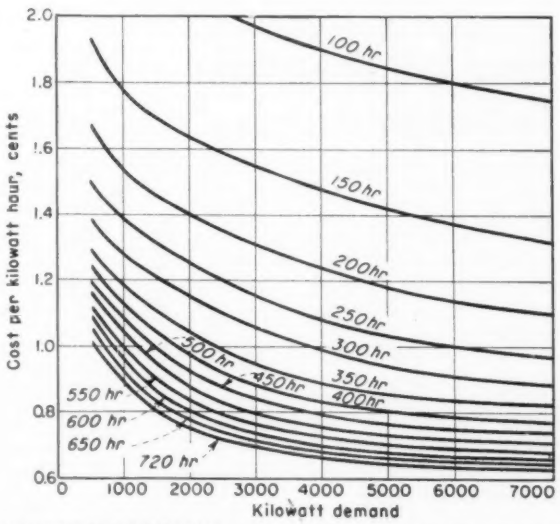
Assumed tabulated load is plotted, *top right*. Kw demand is had by dividing the kilowatt-hours for each piece of equipment by number of operating hours. The plot shows load distribution and contributions to peak or demand loads of each piece of major equipment. A large waterstorage pump is included in the load. This pump is used for filling an overhead tank for fire-protection and sanitary-water purposes. Filling operation might take as little as a half to one hour, but contributes substantially to the demand without adding much to the kwhr consumption. It may be possible to start this pump during some off-peak period like the lunch hour. If this were done, the maximum demand in this case would drop from 551 to 494 kw.

Next, study your electrical power bills for preceding months and note that kw or kva demand is recorded each month along with kwhr consumption. Divide total kwhr by the kw demand giving the *hours use of demand*—a mighty useful figure. For instance, assume the average monthly consumption is 375,000 kwhr and average recorded demand 1250 kw. Then the average *hours use of demand* is 375,000/1250, or 300 hours. Since over a period of a year there is a 730-hour average each month, the load factor of this plant is 300/730, or 41.1%. This ties in with the concept of load factor—an important concept in determining how best to buy electrical power.

As an example, chart, *lower right*, shows a plot of Public Service Co of New Jersey, rate WPL. This chart plots kw demands against cost per kwhr in cents, at varying load factors starting at 100 hours' use of maximum demand and going to 720 hours' use of demand. It is quite evident that as load factor improves for any given demand, there is a reduction in unit cost. For instance, at 4000 kw maximum



KILOWATT DEMAND plotted from table (facing page) obtained by dividing kwhr for each machine by number of operating hours



HOURS USE-OF-DEMAND is total kwhr divided by kw demand. The figure, divided by 730 (average hr in month), is load factor

Formula Method of Calculating Rates

For demands beyond 200 kw, the rate formula, assuming 80% power factor, is:

Monthly cost = \$557.50 + \$1.70 *D* + \$0.0097 kwhr
Where *D* equals kw demand: (1)

This formula was developed from rate schedule as follows:

\$3.50 for the 1st 10 kw demand = \$35.00
2.50 for the next 40 kw demand = 100.00
2.25 for the next 50 kw demand = 112.50
2.00 for the next 100 kw demand = 200.00
1.70 for all over 200 kw demand = 1.70 (D-200)

2,000 x .035 = \$75
3,000 x .025 = 75
15,000 x .015 = 225
30,000 x .013 = 390
50,000 x .0115 = 575
100,000 x .0105 = 1050

Over 200,000 kwhr = 0.0097 (kwhr — 200,000)

\$35 + 100 + 112.50 + 200.00 + 1.70 (D-200) + 75 + 75 + 225 + 390 + 575 + 0.0097 (kwhr – 200,000) = 557.50 + 1.70*D* + 0.0097 kwhr

Similarly the formula for this rate, at 80% power factor and 5% discount, would be:

\$529.625 + \$1.1615*D* + \$.009215 kwhr (2)

Adjusted for power factor and taking the 5% discount, the formula becomes:

$$\$529.625 + \frac{\$129.20D}{\%pf} + \$0.009215 \text{ kwhr} \quad (3)$$

Now if, in addition to adjustment for power factor and 5% discount, primary-voltage discount is taken, the formula becomes:

$$\$529.625 + \left\{\frac{\$129.20D}{\%pf}\right\} - 0.20D + \$0.009215 \text{ kwhr} \quad (4)$$

RATE FORMULA, as developed above, clearly shows inherent savings at a given demand by improving pf and noting discounts

demand, the unit cost at 100 hours is 1.9c; at 720 hours the cost is .665c.

Another characteristic previously discussed is evident from this chart. At any given load factor—let's take 300 hours—the unit cost decreases as demand increases. At 300 hours, cost varies from 1.39c at 500 kw to .88c at 7500 kw demand. Simply stated, the lowest cost for power is had when factors that contribute to maximum demand for any given load are controlled. Since most utilities measure maximum demand over an integrated period of 15 to 30 minutes, some study will quickly indicate how to spread motor-starting cycles over periods exceeding a half hour to reduce the metered demand. Often some equipment can be operated during off-peak periods when most other equipment is down, thus reducing demand in any 15- to 30-minute period during peak hours.

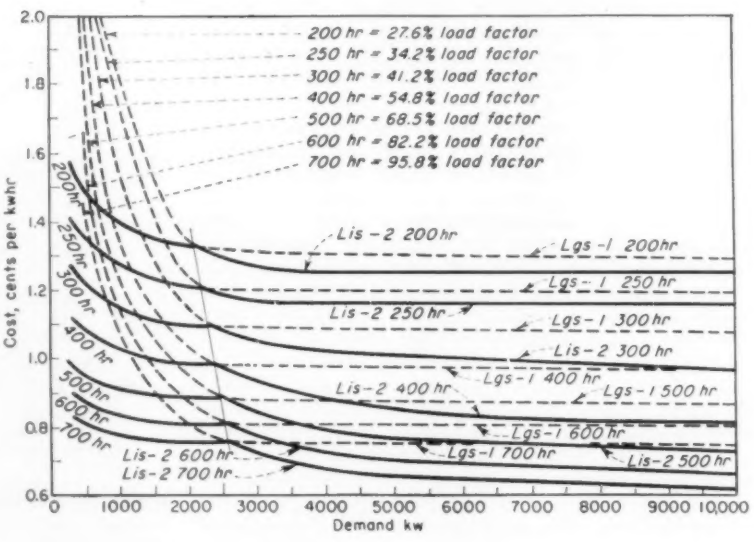
Comparing Rates. Next step is to compare existing rates offered by the local utility to determine whether your plant is operating under the most economical schedule. There are several methods by which rates can be compared. First is the long-hand method calling for detail calculation as indicated in the rate. Modification of this method uses a rate formula to reduce the labor of calculating rates for varying combinations of demand and energy quantities. For example, examine once again Northern State Power Co rate 25.81, tabulated at top of p 76. Then note the monthly cost calculation, *left*.

By use of formula 1 and assuming 1000 kw demand and 400,000 kwhr consumption, the bill per month would be \$6137.50 at 80% power factor and no discount taken. With a 5% discount the bill computed from formula 2 is \$5830.63. If the plant operates at 90% power factor, the bill computed from formula 3 is \$5651.18. Furthermore, if power were purchased at primary voltage and .90 pf plus 5% prompt payment discount, the computed cost per month would be \$5451.18.

This analysis indicates the inherent savings possible at a given demand and consumption by improving pf and taking advantage of existing discounts, if any. If kwhr were kept constant and demand decreased, substantial savings would result. Also, note that a saving of \$200 per month can be made by purchasing power at primary voltage level. But let's see if this would be economical in the long run.

Speed Rate Comparisons By Graphical Analysis

GRAPHICAL METHOD, right, is often used to trim work connected with formula method in rate comparison. Here characteristics of two schedules are outlined visually and most suitable becomes quickly apparent. Method is particularly applicable when plant load is growing and best rate in any one month is not readily spotted. To construct such a chart, first prepare a tabulation of demand, kwhr, cost per month, units. Then assume load factors and compute rate for a range of demands. Where suited, use the formulas 7, 8 and 9, *above on the facing page.*



Buying primary power means buying primary transformer facilities. In the assumed case of 1000 kw demand and 0.9 pf, a substation with nominal capacity of 1200 kva is required. At $20 a kva installed, such a station would cost $24,000. If a 20-year amortization period were selected, depreciation would amount to $1200 per year. Losses and maintenance would tally another $200 each month. Total cost for primary ownership would be $400 per month over a 20-year amortization program as against a $200 per month savings. This means a net outlay of $200 per month. So, in this case, it would not be economical to voluntarily go to primary metering if a choice is available.

Graphical Comparison. Examination by formula can be quite tedious, so consider the graphical method. Do this when the plant's load characteristic is such that it is not evident which rate is best applied in any one month. This is particularly true while load is growing, as during expansion periods. It is important then to know when the load characteristic improves to a point where a better rate can be earned.

To compare two such rates visually, prepare a chart, *bottom, p 78.* Our sample chart compares Louisiana Power Company's rate LIS 2 and LGS 1. Such charts are constructed from tables, which in turn are compiled by assuming load factors and computing the rate for a range of demands covering the plant's requirements. Computation is performed by using formulas 7, 8 and 9, where applicable.

Then calculate bills for assumed demands varying between limits that might be expected at the plant. In this case demands from 500 to 10,000 kw were assumed for each load factor. Results were plotted at both rates. Points, at which the curve for LGS 1 at a given load factor crosses the equivalent load factor curve of LIS 2, were joined by another curve. This latter curve marks the transition point at which it is most economical to transfer to rate LIS 2 from LGS 1. Unit costs to the right of this line are less for the former rate. Opposite is true to left of the line. For instance, at a demand of 1500 kw and 400 hours use of demand, unit cost for LGS 1 is 1.0c per kwhr and LIS 2 is 1.15c. If the load improves to 4000 kw demand, at 400 hour's use of this demand, the unit rate for LGS 1 is 0.97c kwhr as compared with 0.88c for LIS 2. It is obvious that a transfer to LIS 2 is indicated.

Selecting Most Economical Rate Schedule

Comparison of energy and load bracket portion of Louisiana Light and Power Co's rate schedules:

Schedule LGS-1

Demand: $80.00 for the first 25 kw or less of demand
$ 1.40 per kw for the next 175 kw of demand
$ 1.25 per kw for all additional kw of demand

Energy: 1.50¢ per kwhr for the first 5,000 kwhr
1.15¢ per kwhr for the next 10,000 kwhr
0.85¢ per kwhr for the next 30,000 kwhr
0.65¢ per kwhr additional up to 80,000 kwhr or up to 400 kwhr per kw of demand, whichever is the greater
0.45¢ per kwhr for all additional kwhr

Schedule LIS-2

Demand: $2600.00 for the first 2000 kw of firm demand
$1.20 per kw for all additional kw of firm demand

Energy: 0.7¢ kwhr for the first 1,000,000 kwhr, but not less than the first 250 kwhr per kw of firm demand
0.4¢ per kwhr for all additional kwhr

Formula for LGS-1 can be written:

$$\$227.50 + \$1.25D + \$0.0065 \text{ kwhr} \quad (5)$$

or

$$\$227.50 + \$2.05D + \$0.0045 \text{ kwhr} \quad (6)$$

Use formula (5) when kwhr is less than 400 times the demand
Use formula (6) when kwhr is more than 400 times the demand

Formula for LIS-2 is:

$$\$3200 + \$1.20D + \$0.004 \text{ kwhr plus taxes, fuel charges} \quad (7)$$

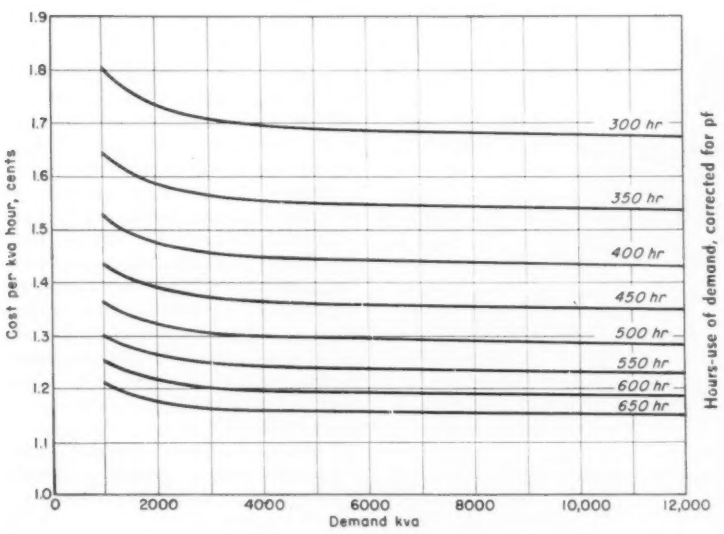
Above is for demands in excess of 2000 kw and 250 hours use of the maximum kw demand

For demands less than 2000 kw use: $2600 + $.007 kwhr (8)

For demands used for 250 hours or less, use the following formula:

$$\$200 + \$1.95D + \$0.004 \text{ kwhr} \quad (9)$$

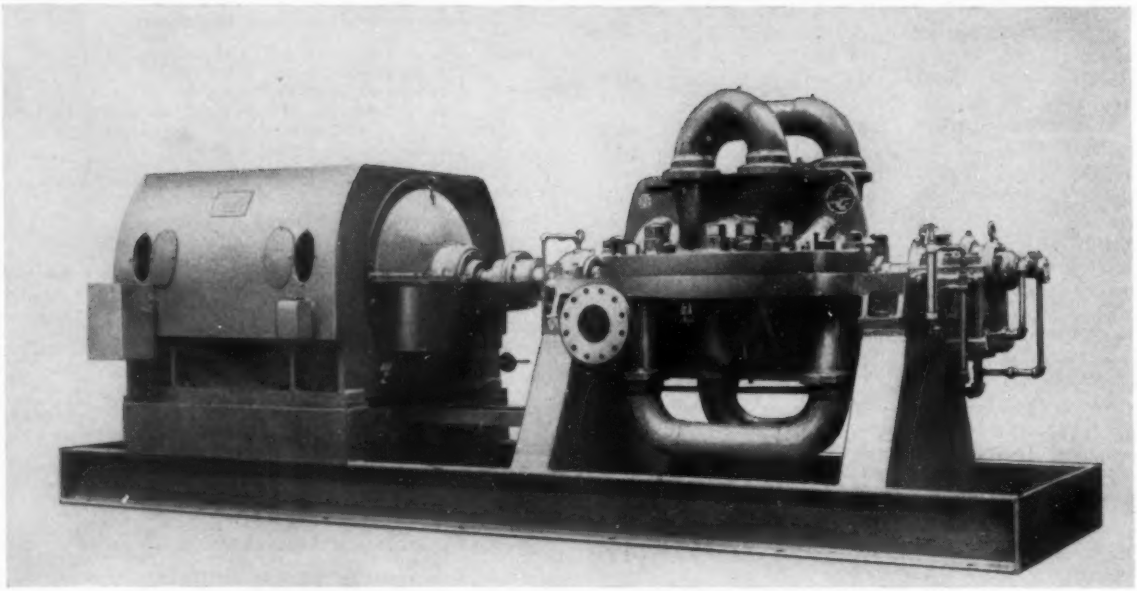
SCHEDULE COMPARISON to find one most suitable is final step. Use either rate tables (above) or charts on the facing page



Kva Schedule Penalizes Pf Other Than Unity

INHERENT PF PENALTY in a kva rate (Rockland Light and Power Co service classification No. 5, *left*) prompts corrective measures. But take care that pf does not become leading at light loads. To compute bill, first determine hours-use of demand. Multiply this figure by pf and enter chart at right side. At the intersection of this latter value and the demand in kva, read off the cost per kva hour.

There is a higher rate generally for customers with their own generators in parallel with utility system. This allows a constant standby charge based on a predetermined billing demand.



AXIALLY-SPLIT boiler-feedwater pump has external loops and is suitable for the mix-temp cycle

Part-Load Operation Of Superpressure Feed Pumps

fourth in this series

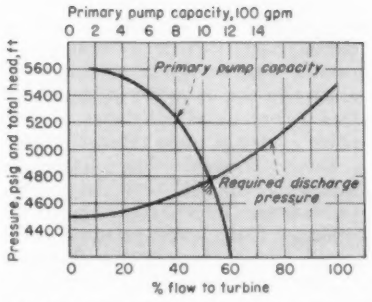
by Igor J Karassik

Manager, Multistage Pump Section, Centrifugal Pump Division, Worthington Corp

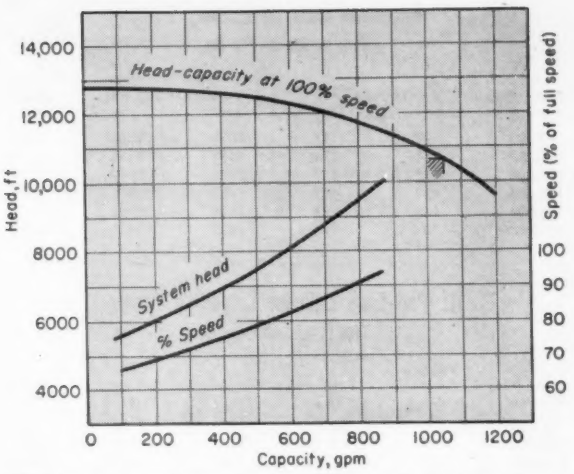
► LAST MONTH we studied the factors in selecting feed pumps for 125,000- and 250,000-kw superpressure units, pp 78-80, March. We're now ready to look into part-load operation of these plants.

Hookup. An ideal arrangement for turbines operating above the critical pressure might be to eliminate the throttle valve and run at variable inlet pressures and steam flows over the entire load range. This can be done by controlling feed-pump speed directly from the main generator. Minimum pressure at zero turbine flow would be about 3500 psi to prevent less than critical pressure in the boiler.

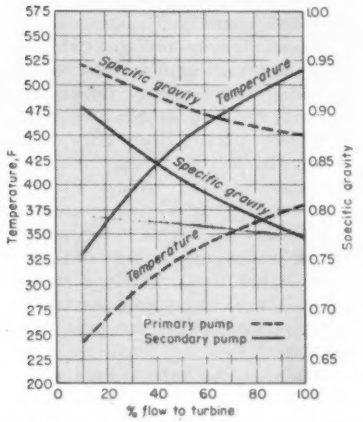
Initial installations of superpressure units will include a turbine throttle valve. A constant pressure of 4500 psi will be maintained at the throttle inlet.



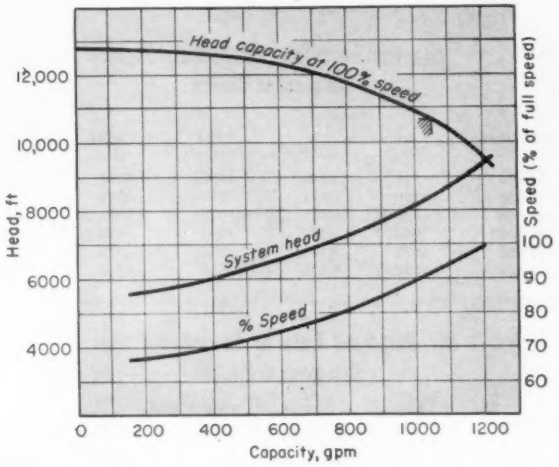
1 Head-capacity and discharge-pressure curves for the primary feed pump



2 Variable-speed operation of secondary pump with two pumps on the line. Curves are based on data, Tables I-IV, p 82



3 Suction temperatures at the primary and secondary superpressure pumps



4 Variable-speed operation of the secondary pump with one pump on the line. Curves are based on data, Tables I-IV

Pressure regulator at turbine throttle will control pump speed to provide the required through-flow and corresponding pump discharge pressure.

Large friction losses between pump discharge and turbine inlet—and the fact that only a portion of the pressure developed by the pump set is subject to speed variation—will cause a wider speed range between full- and no-load conditions than is presently used. Because the feed pump will be designed to run above its first critical speed, it is necessary to analyze the speed range that may be imposed on it.

Fig. 1 shows required final discharge pressure and the head-capacity curve of the primary pump at constant speed. Water temperature and the corresponding specific gravity at the suction of the primary and secondary pumps are plotted in Fig. 3 for various turbine flows.

Calculated part-load data for the primary and secondary pumps are summarized in tables I to IV, p 82, for operation with one and two pumps on the line. Fig. 2 and 4 show the resulting variable-speed requirements for the secondary pumps.

Study of these data shows that a single pump set can handle up to 485,000-lb-per-hr flow to the turbine. This is 72% of the maximum turbine flow, and could fix the greatest load that could be carried with one pump set out of service, since no spare pumps are to be installed. Note that under these conditions the primary and secondary pumps must handle 1220 and 1210 gpm respectively, or 15% in excess of their design capacity. This must be taken into account in considering the adequacy of suction conditions and in selecting driver size.

Fig. 2 and 4 also show that at minimum load the secondary pump will run at as low as 65% of its rated speed. Should the turbine throttle valve be eliminated in the future and the pumps discharge against a pressure considerably less than 3500 psi at light loads, the speed reduction would be even more drastic.

This situation has two effects that need study: (1) Speed reduction must not permit pump to operate too close to the first critical speed. (2) Devices with characteristics similar to a hydraulic coupling are most uneconomical with

I: Part-Load Data for Primary Pumps
Two pumps on the line

Turbine flow, %	Turbine flow, lb per hr	Pump flow, gpm Net	Pump flow, gpm Gross	Total head, ft	Net press., psi	Suction press., psig	Discharge press., psig
10	67,500	79	211	5600	2300	51	2351
20	135,000	145	277	5575	2257	63	2320
40	270,000	295	427	5525	2189	101	2290
60	405,000	450	582	5450	2122	138	2260
80	540,000	610	742	5300	2025	175	2200
100	675,000	774	906	5080	1970	213	2183

II: Part-Load Data for Secondary Pumps
Two pumps on the line

Turbine flow, %	Turbine flow, lb per hr	Friction loss bet. pumps, psi	Suction press., psig	Discharge press., psig	Net press., psi	System head, ft	Pump capacity gpm
10	67,500	1	2350	4501	2151	5500	75
20	135,000	3	2317	4540	2223	5825	153
40	270,000	12	2278	4660	2382	6570	319
60	405,000	27	2233	4860	2627	7440	495
80	540,000	48	2152	5140	2988	8710	680
100	675,000	75	2108	5500	3392	10,100	875

III: Part-Load Data for Primary Pumps
One pump on the line

Turbine flow, %	Turbine flow, lb per hr	Pump flow, gpm Net	Pump flow, gpm Gross	Total head, ft	Net press., psi	Suction press., psig	Discharge press., psig
10	67,500	158	290	5570	2290	51	2341
20	135,000	290	422	5525	2240	63	2303
40	270,000	590	722	5330	2115	101	2216
60	405,000	900	1032	4800	1870	138	2008
70	472,500	1050	1182	4260	1655	157	1812
72	485,000	1088	1220	4130	1598	161	1759

IV: Part-Load Data for Secondary Pumps
One pump on the line

Turbine flow, %	Turbine flow, lb per hr	Friction loss bet. pumps, psi	Suction press., psig	Discharge press., psig	Net press., psi	System head, ft	Pump capacity gpm
10	67,500	1	2340	4501	2161	5540	150
20	135,000	3	2300	4540	2240	5860	306
40	270,000	12	2204	4660	2456	6700	638
60	405,000	27	1981	4860	2879	8110	990
70	472,500	37	1775	4990	3215	9200	1170
72	485,000	39	1720	5020	3300	9500	1210

Part-load operation requires careful study

such a large speed reduction. At 65% of rated speed, coupling efficiency is about 59%. At lower speeds, the efficiency will be further reduced.

It is possible that these problems of part-load operation may be only of academic interest in the early development of superpressure plants because the first units will be base-load installations. But the day may come when load swings will have to be taken on these units as well as on older units operating at lower pressures. So sufficient thought must be given part-load operation at the inception of these plants.

Mix-Temp Cycle. Operating problems, met with stuffing boxes for high pressures and high temperatures in the secondary pump, make it advisable to explore the possibilities of using the mix-temp (or re-entry) cycle* for superpressure boilers. This cycle was developed by Worthington in 1939 to reduce operating pressures on closed heaters without the necessity of installing separate booster feed pumps. Pump stuffing boxes are subjected to relatively low pressure and temperature.

Fig. 5 shows the hookup for two pumps in parallel in a mix-temperature system. Each pump takes its suction from a common header connected to the direct-contact heater. Primary stages of each pump discharge to a common closed-heater suction header. After passing through the heater the water returns to the secondary stages of the feed pumps. Final discharge of each pump is into another common header.

This cycle was developed for axially split feed pumps (POWER, Jan, p 78). In these units the two stuffing boxes are subjected to the lowest pressures in the pump casing. Increase in feedwater temperature after passage through the first two or three stages does not affect stuffing-box operation. Several mix-temp installations made since 1941 demonstrate the suitability of this cycle for 850-psi plants equipped with axially split feed pumps.

Do not assume the mix-temp is a development giving something for nothing. It introduces certain complications that may not be desirable in superpressure power plants. If one of two pumps in parallel is shut down, the internal clearances act as a bypass connection from the high- to the low-pressure elements. Unless a check valve is placed on the suction side of the low-pressure element, hot water will leak into the suction header where it flashes to steam, causing trouble in the pump that is still running.

Even when this valve is used, we still have the problem of a pump full of hot water at a vapor pressure higher than the suction pressure upstream from the valve. This hot water must be bled off and the pump isolated from the discharge side so the unit can start with colder water. All intermediate heaters must be bypassed while starting the pump so it goes on the line cold.

Fig. 5 shows the valves and piping needed for this arrangement. Of course, these problems are not insolvable. Attention is drawn to them to indicate the more complex starting and stopping procedure of the mix-temp cycle.

For this cycle, feed pumps have external loops for exit to the heater and re-entry to the pump. For the lower pressure range for which the cycle was developed, no mechanical changes are made in the pump.

Barrel pumps with double casings designed for higher pressures are more complex when applied to the mix-temp cycle. Inner casing of a barrel pump contains the working parts and liquid handled. It is attached to the outer barrel so it expands independently without

*U.S. Patent No. 2,225,453, Issued Dec 17, 1940 to I J Karassik and assigned to the Worthington Corp.

stressing or distorting the high-pressure clearances or joints.

If we break into the internal element with additional external connections, we not only restrict free expansion but also add complications from the unequal expansion of parts at different temperatures. Basically, the objection to the re-entry feature in the barrel pump is complication of the design.

Simplifying stuffing-box construction might outweigh the disadvantages of this cycle for high pressures. So it will be interesting to study an alternate arrangement using the mix-temp cycle.

Service conditions would be much like those for two pumps in series, except that no extra capacity need be included for leakoff from labyrinths because these would not be used. Pressure at the intermediate takeoff must be selected so that at any reduced speed required the low-pressure element produces enough head to prevent flashing at the suction of the high-pressure element. Preliminary calculations show the service conditions selected for the two separate pumps fulfill this requirement. These are:

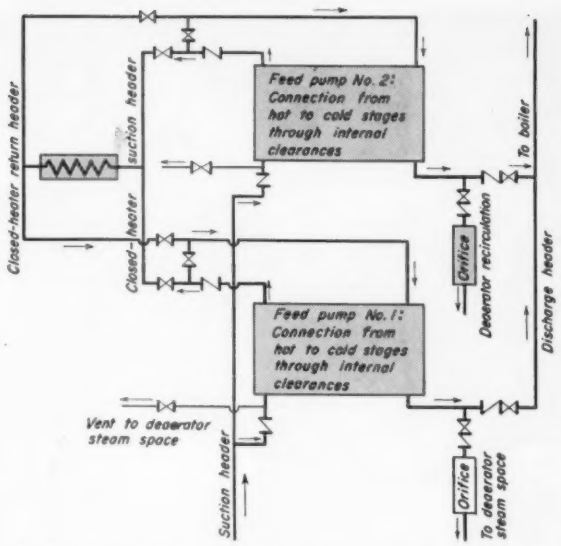
Capacity, l-p element, gpm	925
Total head of l-p element, ft	4730
Capacity, h-p element, gpm	1050
Total head of h-p element, ft	10,670

Combined total head of the two elements would be 15,405 ft. Since it is desirable to have all impellers of the same diameter, it might be necessary to redistribute the total heads listed above between the low- and high-pressure elements. The pump would have six stages and operate at 12,000 rpm.

Operating both low- and high-pressure elements at variable speed would increase the minimum speed from about 65% of full speed to at least 75%. This is a decided advantage since it narrows the total range of operating speeds and may eliminate the problem of running near the critical speed. But a larger variable-speed device would be needed than when using a separate secondary pumping unit.

Note that 100-ft npsh is insufficient at 12,000 rpm to handle 925 gpm (or 1088 gpm if single-pump operation to 72% of turbine flow is desired. It is advisable to limit suction specific speed to 7500. Minimum npsh for this condition is 195 ft for 1088 gpm at 12,000 rpm. To this it is desirable to add a margin against unfavorable transient conditions.

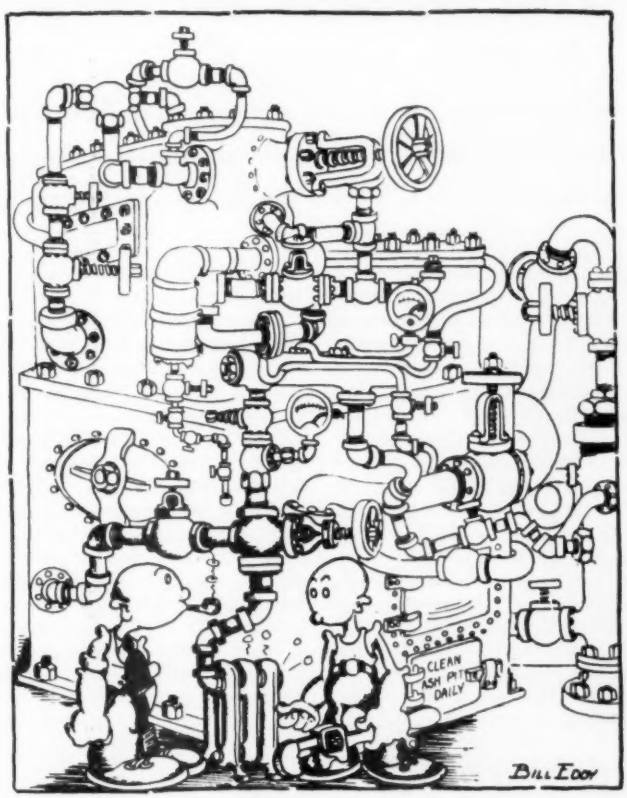
Resulting submergence is impractical and a booster pump would have to be fitted. By double-extending the motor-shaft a single driver could be used for the main and booster pumps. A 4-pole 1800-rpm motor would be used.


Feed pump No. 2: Connection from hot to cold stages through internal clearances
Feed pump No. 1: Connection from hot to cold stages through internal clearances
Closed-heater return header
Closed-heater suction header
Closed-heater
To boiler
Orifice
Deaerator recirculation
Discharge header
Vent to deaerator steam space
Suction header
Orifice
To deaerator steam space

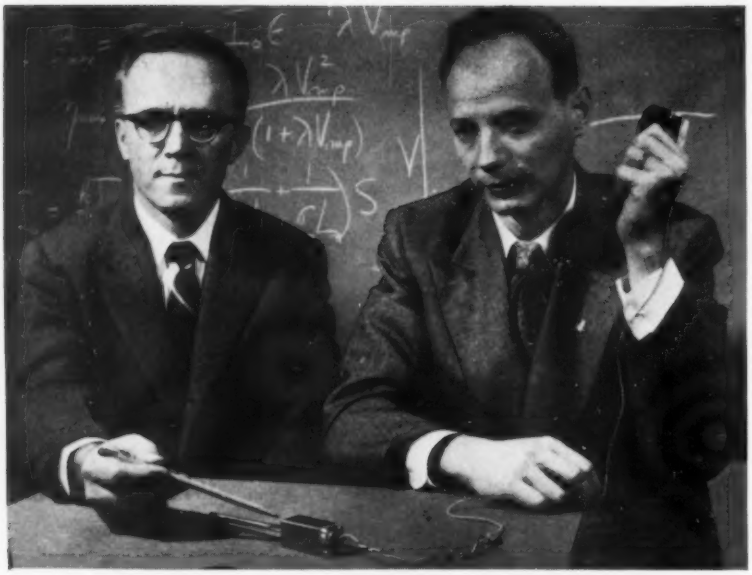
5 Piping and valves for two pumps operating in parallel on mix-temp boiler-feed cycle. See the text for details

No. 4 of the Bill Eddy Cartoons

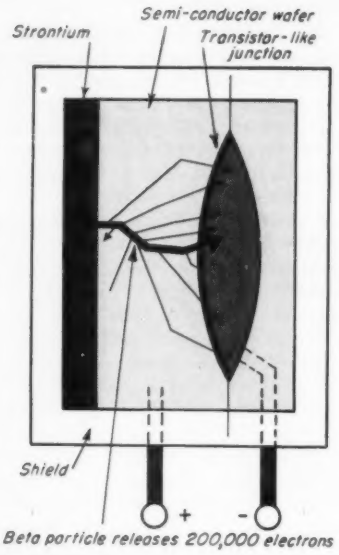
Repeated by request



"But Mac, is it practical?"



TOP RCA SCIENTISTS demonstrate atomic battery by click heard in connected ear phone. New development in the radioactive battery consists in coupling a wafer of semiconducting crystal (germanium or silicon) to strontium-90. An impurity material has been alloyed into the crystal to form a junction, similar to a transistor



BETA PARTICLE from strontium releases 200,000 electrons in semiconductor, building up cell voltage to 1/5 v as they flow across transistor-like weld

Will Atomic Battery Change Present

Since RCA announced its atomic battery, much has been said about tomorrow's power coming from atomic packages, bypassing thermal phase. Here's the opinion of *Power* editors

► LATEST ENTRY in the radioactive-battery field was introduced in recent months. The contribution consists in electrically coupling a battery's radioactive source to a transistor-like wafer, which instantaneously releases some 200,000 electrons for each electron (beta particle) it receives from the radioactive material. This simply means that we now have a battery 200,000 times as effective as any previous similar device. It's this multiplication in the number of available electrons, not the conversion of atomic energy into electrical energy, that keynotes the development.

Is It New? Generation of electrical energy by collecting beta particles from a radioactive source is not new. As early as 1913, Britain's H G J Mosley produced high-voltage by collecting beta particles from radium suspended in a vacuum. Mosley's apparatus, *sketch, facing page,* was made up of two concentric spheres with a vacuum tap to keep the volume between spheres at a low absolute pressure.

Center sphere or source electrode was a quartz bulb containing about 20 millicuries of radium. Bulb wall was thin enough to permit the beta particles to penetrate, but thick enough to absorb the alphas. Source of beta electrons was supported by a thin quartz rod attached to the inside wall of outer sphere that collected the electrons. Inner and outer spheres were covered with a conducting coating of silver forming the cathode and anode. Potential difference between electrodes was measured by an instrument in vacuum connection.

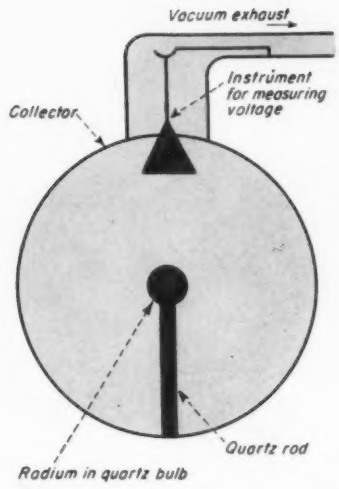
When Mosley evacuated the inner chamber between spheres he repeatedly measured about 150 kv before the device discharged through internal flashover. Current was found in the order of 10^{-11} (.00000000001) amperes.

Some 40 years later, 1952, a similar vacuum setup was made but with strontium and yttrium (Sr^{90}—Y^{90}) as the radioactive source. With improved vacuum techniques and better electrode design, a difference of 365 kv was noted.

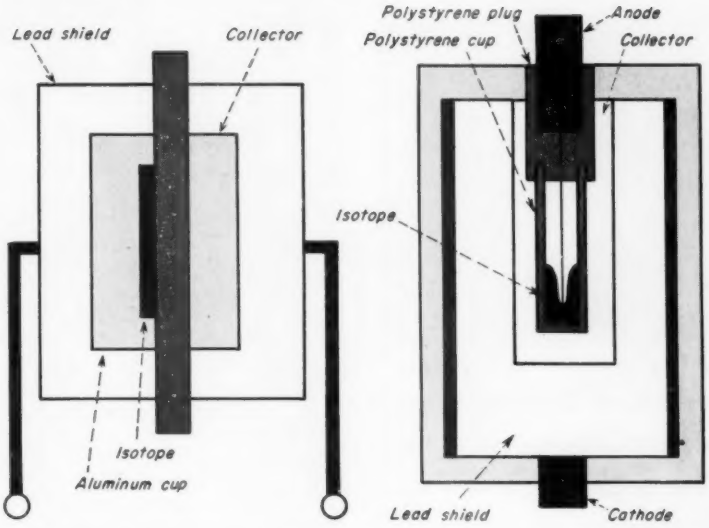
In the early 1950s, work was under way toward the development of a radioactive battery using a solid insulator rather than a vacuum dielectric. The solid material promised increased reliability. As reported in *Nucleonics* magazine (Dec 1953), a radioactive battery with a polystyrene dielectric was available, developed by the Radiation Research Corp. This device was capable of discharging 40×10^{-12} amperes from a 7000-v build-up after two weeks on the shelf. Previous to this, Jan 1952, the polystyrene insulated unit was demonstrated using strontium.

How Big? With the transistor in tandem, the "new" battery boasts one-fifth volt and 5 microamperes. And the resulting millionth of a watt of more useable power comes about because every electron shot off by the strontium in its 20 year half-life, hitting transistor junction, knocks 200,000 electrons loose in silicon element in transistor.

At present, strontium-90 is the radioactive source material. Virtually any radioactive material could be used, but



VACUUM DEVICE: earliest radioactive battery using radium as isotope. Mosley developed it in 1913, measured 150 kv at near zero current between both spheres



POLYSTYRENE INSULATOR replaced vacuum dielectric about 1952. Then the device was capable of discharging 40×10^{-12} amperes from a 7000-v build-up, after 2 weeks on the shelf. Unit is well suited for small-current, long-life applications at low temperatures. Strontium-90, rather than radium, is the battery's radioactive source

Methods of Electrical Generation?

strontium was chosen because of its high beta radiation, long life and relatively low shielding requirements. Since strontium-90 is at present a radioactive waste material (byproduct of atomic reactor operation) it will be in more plentiful supply as more reactors are built.

In addition to Radio Corp of America, there are others who lay claim to development of a radioactive battery with similar characteristics. The Ohmart Co, for one, has stepped forward as having released an atomic converter in 1951.

Radioactive battery developers are well aware of the battery's present minute field in the broad electrical picture. And they are quite optomistic as to its future in the micro-power field. But speculative thinking based on newspaper accounts of the development have overexcited the layman's imagination. Cool analysis quickly rules out the economic practicality of developing major chunks of electrical power by this method.

With strontium-90 at the present Atomic Energy Commission price of $500 per curie, the cost of meeting a kilowatt of electrical demand becomes $25,000,000,000 since each cell contains 50 millicuries of Sr-90. Even if the price of strontium drops to $2 per curie with increased demand, the bill will still be $100,000,000 per kw investment. These figures just include cost of radioactive material, discounting entirely the cost of the cells, transistors and shielding.

Dropping the economics for the moment, it's interesting to note the similarity in principle of the radioactive battery and the photocell multiplier. Photocell is widely used in light meters. Where latter uses a semi-conductor, electrons are released by radiation upon it. In the radioactive battery the radiation is byproduct beta particles rather than light rays. As a novelty, small motors have been running for years in leading labs, powered solely from free light falling on sensitive surface of a photographer's exposure meter. But the cell fails to be economical as a power producer by a large factor.

Chemical Cells. Using a similar goal, but a different technique, the British recently announced a high-efficiency cell that turns chemical fuel directly into electricity. This cell (announced in the BEAMA *Journal*, Jan 1954, pp 6-12) uses two diaphragms of porous nickel closely spaced with an electrolyte between. The electrolyte is potassium hydroxide; gases are oxygen, hydrogen.

A single such cell produces less than 8 volts. But, unlike the radioactive cell, since its working parts are thin, it's a relatively simple matter to gang many in series for higher voltages. An efficiency figure of greater than 50% has been mentioned by cell developers.

The Future. Heralded possible future for the atomic battery, from one source, earmarks boilers, engines and electrical generators as becoming "elements of the past." The prediction is that, if the promise of the radioactive battery is fulfilled on a large scale, atomic batteries can be installed at or near the place where power is to be used. The aim is to design such batteries as "on-the-spot" energy sources for specific installations, radio beacon or a home.

But from where we on POWER stand, the radioactive battery is not now, nor in the foreseeable future, a device that can be used for production of sizable quantities of electrical power. Much as engineers would like to skip the huge thermal phase in the generation of electricity, there is little prospect of doing so, right now.

Let's not look upon this development as of revolutionary consequences, outside the possible field of electronics.

"When you're doing a job right, you're doing it safely," says Aldo P Osti, safety engineer at Brooklyn plant of Chas Pfizer & Co, Inc. Here's how the company set up a safety program in service departments. Themes change monthly in this plan designed to . . .

Prevent Accidents! Monthly Safety

► IN THE LAST FEW YEARS, accident frequency* has fallen from 9.65 to 3.75 at the Brooklyn plant of our company, Charles Pfizer & Co, Inc. In the same period, we have been making continuous changes to produce the new antibiotics our research laboratories are developing. Here's the story behind the decreasing accident rate.

When management realized that the responsibility for safety was too much for only part-time attention of people whose primary duties are elsewhere, they created the position of safety engineer, assigning it as a one-man full-time job. The plant was already in good shape, but safety emphasis was confined to housekeeping and fire control.

Prevention. These two factors are still important parts of our program, but chief emphasis has changed to accident prevention.

We were surprised to find that medical department records over a 10-year period showed a discernible pattern in plant accidents. There were more slips and falls in February than any other month, more strains and sprains in September, more eye accidents in March.

These facts gave us an important lead in reducing accidents. We would try to prevent the most prevalent accident each month. But we had to go a long way into the theory of accident prevention to set up an effective program.

First, we discovered that accidents are caused either by unsafe acts or conditions, but mostly by unsafe acts. This meant that safety had to be sold to each employe.

Then we learned that accident prevention is (1) not only a matter of being humane and considerate of fellow employes, but (2) it is also good business because it saves money. These two facts gave us a direct approach to everybody in the plant.

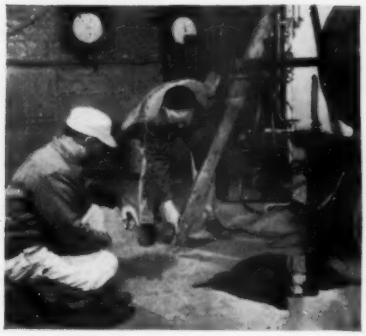
We could tell employes that preventing accidents cuts down pain, disabilities, financial loss, sudden death. We could tell management that for every dollar spent directly for accident costs (medical and compensation expenses) there are four times as many dollars spent for indirect or hidden costs.

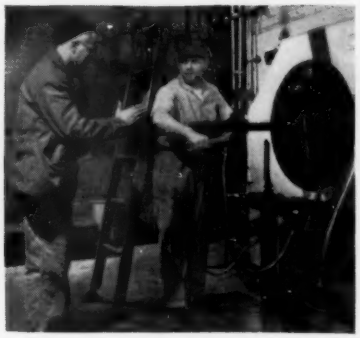
These hidden costs include time lost by injured workers, loss in earning power, economic loss to injured worker's family, time lost by fellow workers, time lost by supervisors, cost of breaking in replacement for the injured man, damage to tools and equipment, time lost while equipment is out of service, spoiled work and material, failure to fill orders, overhead costs during work disruption.

3-Point Plan. Now that we had an approach, we had to find a way to interest all personnel. This gradually evolved into the 3-point plan pictured at top of page 87. We had to create and maintain interest, get the facts on all accidents and potential hazards, and follow up with action.

*Accident frequency equals number of lost-time injuries multiplied by one million, divided by employe man-hours of exposure.

3 steps in accident prevention that produce results in a busy plant





1 CREATE INTEREST

An effective program of accident prevention must enlist and maintain the interest of the entire personnel. Regular monthly safety meetings at all levels from top management down are big factors. Welding-shop foreman, *above*, discusses use of safety glasses, asks each man to feel personally responsible for his own safety and that of others around him

2 GET THE FACTS

Periodic inspection of structures, machines, tools, equipment, and employe procedures shows up many potential hazards that might cause accidents. Each month two different foremen tour shop areas looking for actual and potential dangers. Close relationship with the medical department helps in investigating and analyzing each accident that occurs

3 FOLLOW-UP

Removing hazards discovered during plant inspections, *above*, is front line of accident prevention. Critically analyzing foremen's and medical department's reports of each accident indicates trends, suggests preventive measures. These are pointed out in memos, brought up at safety meetings, thus highlighting unsafe acts or conditions to avoid

Program Uses This 3-Point Approach

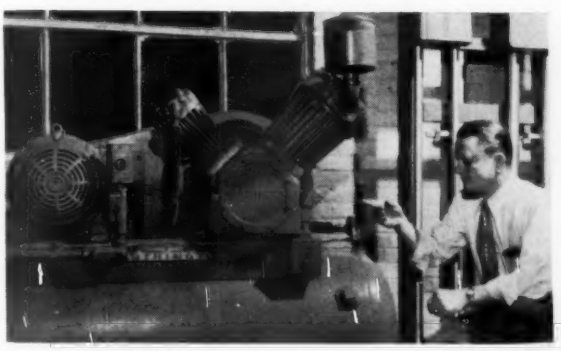
Safety Committee. With top management's approval, we appointed a general plant-safety committee that consists mainly of department heads and supervisors who can influence the personnel under them. This committee discusses procedures, reviews accident reports, presents safety messages to foremen and employes. Next step was to start regular plant inspections by supervisors and foremen, who look for potential accident hazards and see that they are corrected.

We prepared report forms to give the pertinent facts of each accident and explained their use. Through regular safety meetings we began to train all supervisors, foremen and employes in accident prevention. The medical department cooperated by providing information on all injuries treated there.

As part of the plan to emphasize prevention of one common type of accident each month, we now circulate safety memos highlighting the theme for that month. This information is used as a topic for safety-meeting discussions at all personnel levels, from department-head confabs to foreman-employe meetings. Unsafe acts or conditions that can be avoided are highlighted. Posters, films and various gimmicks further stress the subject.

This method of education points up the important fact that each employe is responsible for his part in an accident-prevention program. Selling safety and creating enthusiasm for the program is a big part of the safety engineer's job.

↓ Schedule starts with inspection

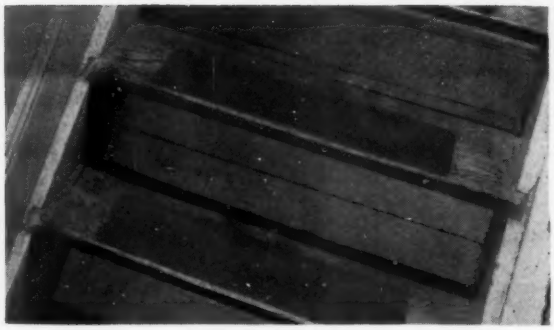


JANUARY: General inspection

Because many people believe in starting the new year right, we begin with general inspection of the plant. Supervisors check all equipment for potential hazards, also examine building structures, floors, movable items like ladders, trucks. They try to get a "fresh view," spotting items generally overlooked

More on next page ▶

These monthly safety themes gear plant's accident-prevention program to avoiding the mishaps most likely to occur



FEBRUARY: Slips and falls

Ice and snow make driving and walking outdoors generally treacherous. As people are more conscious of slipping and falling, our safety program inside the plant emphasizes use of nonslip stair treads, *photo*, safety on ladders and scaffolds, keeping aisles clear, cleaning up oil, water, etc, on floors and walks

MAY: Dermatitis control

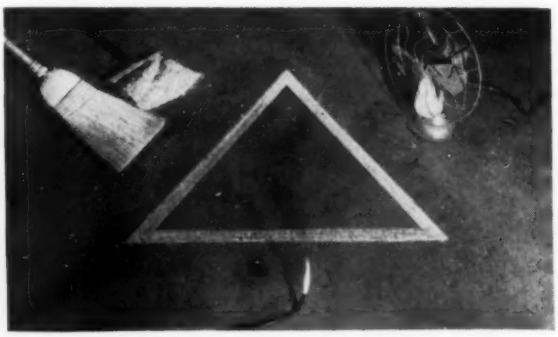
The skin is more than ordinarily susceptible to developing a rash in May because climatic changes affect the pores and perspiration helps irritants stick to the skin. We urge use of protective equipment like gloves, aprons, creams to prevent skin inflammation. Safely-clad employe above steams out corrosive-material pump

JUNE: Hand tools

Fingers, hands and arms, the most exposed parts of the body, are involved in over one-third of all reported injuries. And spring may induce day-dreaming, increasing the hazard. We emphasize using the right tools the right way, keeping them in good condition, putting away when not in use. Millwright shop cabinet *above*.

SEPTEMBER: Sprains and strains

When weather grows cooler, muscles tend to become taut and likelihood of strains and sprains increases. Preventive program shows correct method of picking up articles: Face the object, bend from the knees, keep back erect, push up with legs. Foreman of blacksmith shop demonstrates, *above*, with mechanical man



OCTOBER: Fire prevention

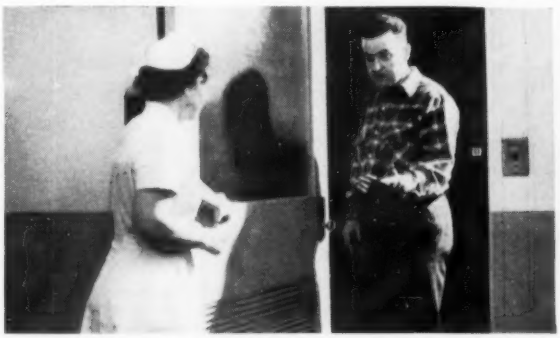
A week in October is set aside nationally for fire-prevention week. So our plant program emphasizes good housekeeping, cleaning up waste materials, and arranging supplies in an orderly fashion. This diagram, *above*, dramatically points up the three essentials of any fire—ignition, fuel and oxygen

MARCH: Eye control

There is more dust in the air during this windy month than any other time of the year. And dust finds its way into the eyes. Our eye-control program points up use of safety glasses, visors, *above*, face shields, etc, for grinding, chipping, welding and other operations where flying particles may affect eyes or face

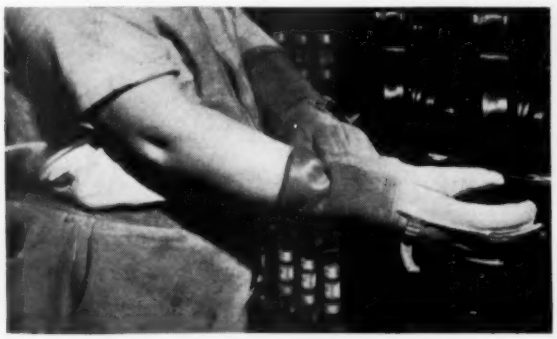
APRIL: Housekeeping

An industrial housekeeping program promotes order and cleanliness in the plant much as spring cleaning gets rid of dirt in the home. The benefits of stressing plant housekeeping include orderly material storage, elimination of fire and accident hazards, conservation of space, time and effort, improved employe morale



JULY: First aid

People in unfamiliar surroundings, whether handling jobs on a fill-in basis at the plant or away from home on vacations, are more likely to be injured. Safety program teaches what to do in case of injury, points out need for reporting to medical department for prompt treatment any time an injury occurs in the plant



AUGUST: Hazardous materials

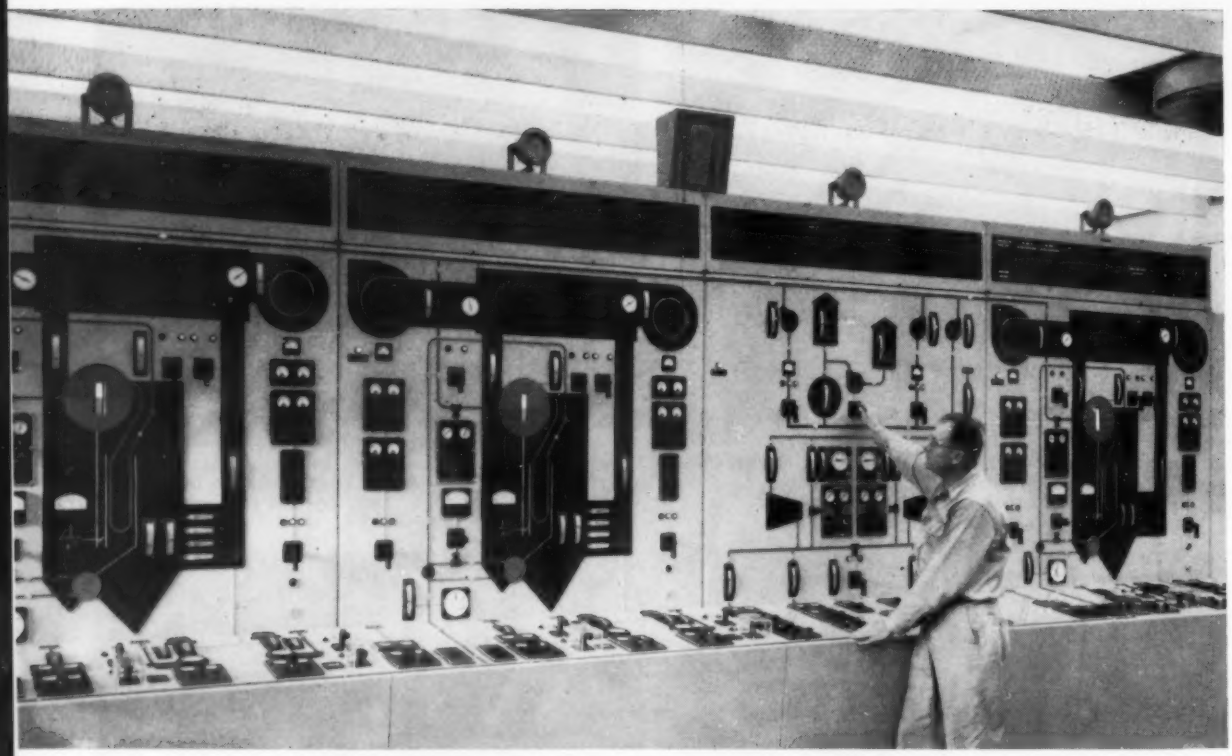
During the hot season, danger of sunburn and heat prostration is great, but so is tendency to discard gloves, face shields, other protective clothing. Newspapers emphasize use of creams and lotions. Our program points out continuing need for wearing protective clothing near electrical equipment, corrosive materials

NOVEMBER: Handling materials

Inventory month necessitates more handling of materials than an ordinary month. Supervisors study the types of material to be moved, consider what special safety equipment will help avoid accidents. Depending on the work involved, company subsidizes purchase of safety shoes, provides gloves, aprons and goggles

DECEMBER: Electrical control

The Christmas season sees more use of electricity in homes than any other time, makes employes more conscious of its value. Program stresses using electricity safely to avoid its dangers: shock, burns, death. Electrician above pulls fuse with the proper protective equipment—fuse puller and safety gloves



GRAPHIC panels, CENTRALIZED operation, MINIATURE instruments combine to provide...

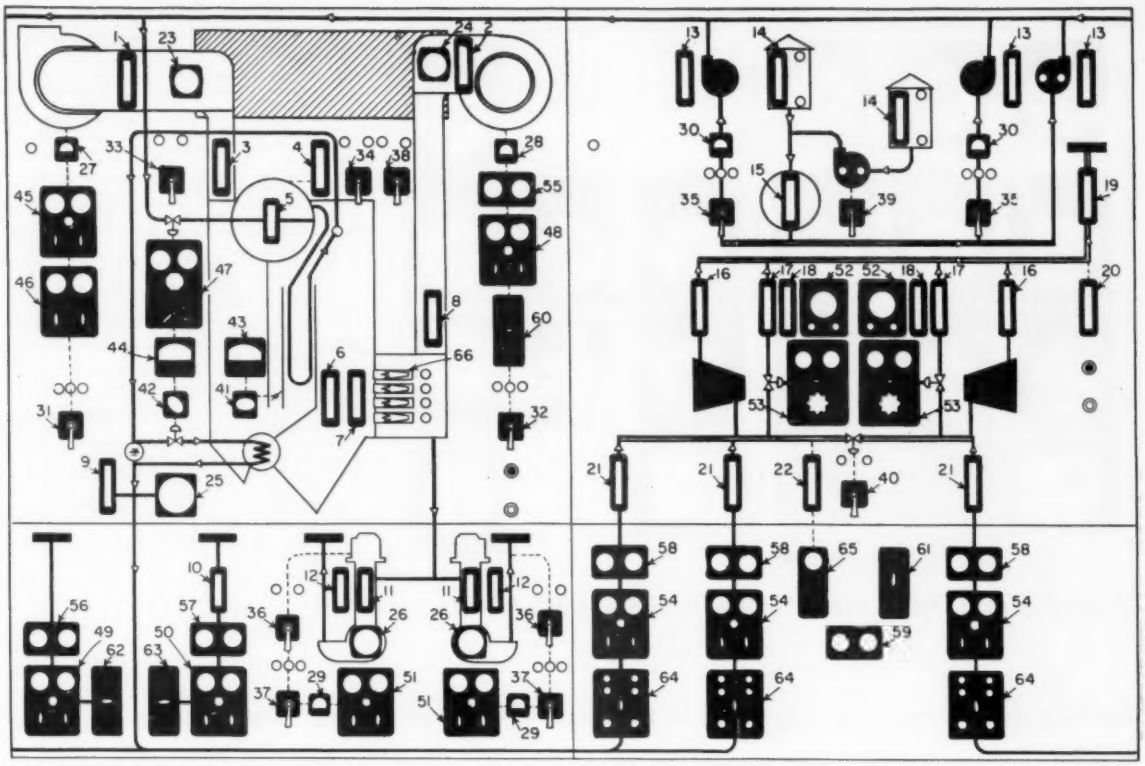
Streamlined Industrial Power Controls

In the hands of one topnotch man, controls keep a plant running more economically and safely. Here's how Western Electric Company's Hawthorne Works puts this idea to work successfully

By C E MORROW and R F BORN, *Western Electric Co, Chicago, Ill.*

► WITH MANUAL MANIPULATION of power-generating controls, it is nearly impossible to achieve optimum operating efficiency and low attendance cost. But with centralization of automatic controls even further economies can occasionally be realized. Such was the case with the recent rehabilitation of Western Electric Company's Hawthorne Works power plant in Chicago, Illinois. Centralized supervision of automatic controls provided fewer but better jobs, simplified the training program, minimized the effect of human error, and produced safe, economical operation.

Modernizing this power plant consisted of replacing 16 stoker-fired boilers, at 175 psig, 500 F, with three steam generators, fired with pulverized coal, natural gas or oil, at 900 psig, 835 F. Their nominal capacity is 150,000 lb per hr, but for 2-hour periods they can operate at 200,000 lb per hr. These units supply steam to two 5000-kw noncondensing turbines exhausting into the old 175-psig system. Any difference between the 175-psig demand and the exhaust from the high-pressure turbines is made up through pressure-reducing desuperheating stations. Two-thirds of the high-voltage



Boiler panel, front view

Master panel, front view

Pneumatic Receiver Indicators
1. Draft, i-d fan suction
2. Draft, f-d fan discharge
3. Draft, boiler outlet
4. Pressure, steam drum
5. Drum level
6. Draft, furnace
7. Oxygen leaving boiler
8. Windbox pressure
9. Pressure, superheater outlet
10. Fuel-oil pressure at guns
11. Draft, mill suction
12. Mill-discharge pressure
13. Boiler-feed discharge pressure
14. Demineralized-water storage level
15. Deaerator-water level
16. Steam flow to topping turbines
17. Steam flow from 900-psi pressure-reducing valves (prv's)
18. Temperature from 900-psi prv's
19. Total steam flow from boilers
20. 170-psi header pressure
21. Boiler steam flow
22. 900-psi header pressure

Selsyn Receiver Indicators
23. Flue-gas temp from air heater
24. Air temperature to air heater
25. Superheat temperature
26. Mill-discharge temperature

Ammeters
27. I-d fan motor
28. F-d fan motor
29. Pulverized motor
30. Boiler-feed pump motor

Starting Control Switches
31. I-d fan motor
32. F-d fan motor
33. Dust-collector fan
34. Air-heater motor
35. Boiler-feed motor
36. Coal-feeder motor
37. Coal-pulverizer motor

Control Switches
38. Air-recirculation damper
39. Transfer-pump demineralized storage tanks
40. Motor-operated 900-psi segregating valve
41. Superheat gas damper
42. Superheat control valve

Position Indicators
43. Superheat gas damper
44. Superheat control valve

Manual Automatic Subpanels
45. I-d fan hydraulic coupling
46. I-d fan inlet damper
47. Feedwater control
48. F-d fan inlet dampers
49. Gas-flow control
50. Fuel-oil control
51. Coal-feeder control
52. Desuperheat control, 900-psi prv
53. Pressure control, 900-psi prv
54. Boiler master

Monitors
55. Air-flow regulator
56. Gas-fuel-flow regulator
57. Oil-fuel-flow regulator
58. Fuel splitter
59. Flow loading

Selector Switches
60. Air-flow control, steam flow or master load
61. Master loading, pressure or flow pressure

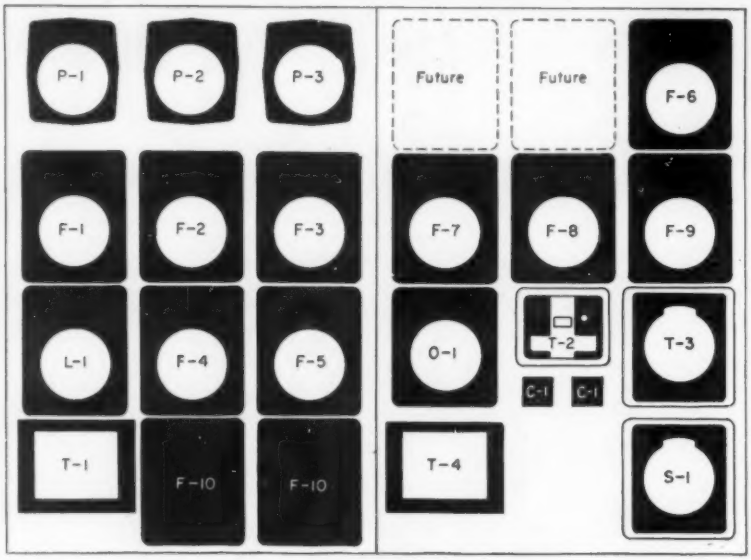
Base-Load Selector Switches
62. Base load or master load—gas
63. Base load or master load—oil

Miscellaneous
64. Minimax subpanel
65. Remote-control point setter-steam pressure regulator
66. Flame indicator

switchgear has been replaced and the controls for the old and new generators and feeder breakers have been centralized. All power is now generated at 12 kv.

Contrast Old and New. As the design of the equipment progressed, it was apparent that automatic steam generation control insuring optimum combustion and steam utilization efficiency, together with safeguards to personnel, equipment and continuous operation, were an economic necessity. Such controls were of a complicated nature, requiring many monitoring devices. Instruments and switching controls on the old 12-kv board were difficult to maintain. It was evident that the board should be replaced.

In the old plant at the Hawthorne Works, very little of the boiler control was automatic. Switchgear controls were mounted on a vertical board extending half the length of the turbine operating floor—about 80 feet. Supervising both steam and electric-power generation, which required attendance at widely separated points, was the responsibility of several operators. The new design features a centralized control room. The thinking here is that plant operation is



Master panel, back view **Boiler panel, back view**

Rear-Panel Instruments

P-1	Pneumatic recorder: pressures, 900-psi and 170-psi steam, 1500-psi and 225-psi feed water
P-2	Pneumatic recorder: pressures, 40-psi city water, 80-psi house water, and 90-psi air
P-3	Pneumatic recorder: pressure, 150-psi fuel oil
F-1	Electronic recorder: steam flow, 900-psi to 170-psi prv No. 1
F-2	Electronic recorder: steam flow, 900-psi to 170-psi prv No. 2
F-3	Electronic recorder: steam flow, 170 psi to process
F-4	Electronic recorder: steam flow, 900-psi generated totalizer
F-5	Electronic recorder: water flow, demineralized boiler makeup
F-6	Electronic recorder: steam flow, 170 psi to 26th Street shops
F-7	Electronic recorder: steam flow and feedwater for boiler
F-8	Electronic recorder: gas flow for boiler
F-9	Electronic recorder: oil flow for boiler
F-10	Boiler steam-flow totalizer
T-1	Electronic recorder: miscellaneous temperatures' strip chart
T-2	Electronic superheat controller
T-3	Electronic superheat recorder
T-4	Electronic recorder: boiler temperatures' strip chart
S-1	Electronic recorder: smoke density
L-1	Electronic recorder: demineralized storage levels
O-1	Electronic recorder: oxygen analyzer at boiler outlet
C-1	Coal-scale counters

Safety features are the best insurance for your plant investment

safer and more economical in the hands of one good operator than of several who are not so good—especially when they make decisions without consulting each other.

So that the operator will know at a glance exactly what piece of equipment each instrument controls, a graphic panel board has been designed in color. Each piece of equipment is shown in its correct position in the power-plant cycle. Miniature indicating instruments are mounted in the cycle at the operation they either measure or control. The purpose of each instrument is clearly defined in one simplified but vivid picture of the entire power plant.

The control room is an enclosure 30x40 ft at the center of the operating floor. The dividing wall between the turbine and boiler rooms serves as one wall. For the other three walls, the top half is glass, making it possible to see almost all the turbine floor from the control room. To make the best use of the limited space, only indicating instruments are front panel-mounted. Recorders and totalizers mounted in the rear of the panel are checked periodically. The rear location also has the advantage of permitting prolonged inspections of recorded data without interfering with operation.

The electrical control board is made up of a bench and a duplex vertical section. Breaker controls are mounted on the bench, showing graphically their proper position in a miniature bus. All necessary indicating instruments are front-vertical panel-mounted. Relays and recorders showing frequency and voltage are mounted on the rear. From this board, generators are put on or taken off the line, voltage and frequency controlled, and substation feeders switched.

Combustion Controls. The electronic-pneumatic control system operates the boilers when firing pulverized coal, natural gas or fuel oil, or the three simultaneously. Changes in either steam pressure or steam flow and pressure actuate master controllers. During summer weekends when boiler output is below 20% of meter ranges, only steam-pressure control is used.

Variations in steam flow or pressure cause the master regulators to signal the air flow, fuel and i-d-fan speed regulators. These regulators respectively change f-d-fan inlet damper position, coal feed speeds or position valves controlling flow of oil or gas, and regulate i-d-fan speed by adjusting the coupling between the fan and motor. Differential meters on air, oil and gas flow provide check-back signals to the respective regulators. The air flow check-back signal readjusts f-d damper position to maintain correct air to fuel ratio. Oil and gas flow are readjusted in like manner to maintain correct ratio to coal feed when multiple fuels are fired. Furnace-draft and mill-suction regulators position the i-d fan and mill-suction dampers. A load splitter proportions load between boilers, and fuel splitters maintain the desired ratio of fuel when more than one fuel is burned simultaneously. The air-to-fuel ratio may be changed at the panel to compensate for fuels burned.

Feedwater Control. A pneumatic regulator, acting in response to feedwater flow, steam flow, and drum-water level, controls boiler feed supplied from a common header. The feedwater control valve, positioned by these three influences, accurately proportions water flow to steam output and maintains drum level within desired limits.

Steam Temperature. Automatically controlled water-drum desuperheaters and manually operated flue-gas bypass dampers maintain steam temperature at 830 F, with loads between 50 and 100% of maximum capacity and feedwater temperatures either 220 or 360 F. The drum desuperheater is positioned by a 3-phase motor. Signals controlling the motor are computed from steam temperature and air flow. One setting of the bypass damper, which controls the flow of flue gas over the low-temperature superheater surface, will permit automatic control for 40% of boiler capacity.

Pressure Reduction. Two pneumatic pressure-reducing desuperheating stations in parallel with the turbine-generators are kept in standby condition to provide additional 170-psig 500-F steam when demand is in excess of the turbine exhaust flows. The reduced pressure is controlled at

about 5 psi less than the turbine exhaust pressure to maintain stable flow from the turbine exhaust to the 170-psig steam header. The turbine governor acts to hold the exhaust pressure constant. Reducing stations are equipped with load-limit controls to prevent 900-psig header pressure from falling below 600 psig. Steam temperature leaving the desuperheaters is held to a plus or minus 5-F variation.

Safety Features. Emphasis here is on protection from furnace explosion. An electronic eye is always focused on the flame. Should the flame fail, gas or oil feed is automatically cut off. When coal is burned, loss of ignition sounds an alarm, but does not trip the feeders. Flame pictures on the graphic boiler panel show the control-room operator the presence of ignition.

Pressure-responsive switches on the furnace and windbox act as additional safeguards against explosion. If furnace conditions reach a positive pressure of plus one inch of water, a control-room alarm sounds and a 5-second time-delay relay acts to trip f-d fans and fuel feed. In addition, the windbox pressure switch operates instantly to sound an alarm and trip fuel feeds if windbox pressure becomes negative. This setup protects against poor draft and air-flow regulation resulting from negative windbox pressure. It also insures that the boilers will shut down if the f-d fan fails or the f-d dampers stick closed. To purge the furnace of possible explosive conditions, a system of electric interlocks insures that the fans and fuel feeds will start in the proper sequence, and that the fans will operate for 30 seconds before fuel feeds start.

The boiler-panel, I, and master-panel alarms, II, are listed at right. If any of the control functions fail to perform correctly, a horn at the top of the panel sounds. Source of the trouble shows up on the alarm panel in illuminated lettering, spelling out "Flame Failure," etc.

Local Alarms. A local panel in the boiler room announces failures that must be corrected there. These are shown in Table III of boiler-room alarm panels at right. The alarms indicating no coal flow to the feeders are duplicates of those in the control room. Coal-feeder shear-pin failures show up on the boiler-room alarm panel only. These were not repeated in the control room since corrective action must be immediate. If it is not, the control-room operator is informed of the resulting flame loss by an alarm and loss of flame picture. If the deaerating heater exceeds its high- or low-level limits, an alarm sounds in the boiler room only. This saves time in correcting the trouble. There is a level indicator for this heater on the master panel in the control room. The remaining functions covered by the boiler-room alarm panel are not repeated in the control room since they do not affect over-all plant operation.

Operator's Job. Study of the front and rear panel drawing on the preceding pages shows that the operator has a complete picture of conditions at all times. The boiler panels tell him whether operation is normal. If necessary, he can adjust fuel-air ratio, furnace draft, superheat temperature, and other key control items. The master panel tells him the load on each boiler, steam flow to the high-pressure turbines, and flow through the pressure-reducing stations. He can also check the amount of treated-water storage, water level in the deaerator, boiler-feed pump discharge pressure, and other information important in over-all operation. If trouble develops that cannot be cleared by adjustments on the control board, an intercommunication system is available.

The operator should spot trouble as it develops, and take rapid corrective action. The front of the panels tells him what is happening *now*. The rear of the panels gives him operating trend information. With a thoroughly trained and alert man on the job, Western Electric gets the continuous, safe and economical operation demanded of its power services.

I: Single-Boiler Panel Alarms

Function	*Cause of Alarm*	*No. per Unit*
Drum-water level	High	1
	Low	1
Superheated steam	Temperature outside limits	1
	High conductivity	1
Coal flow	No flow to scale	2
	No flow to feeder	2
Combustion control	Alarm power failure	1
	High positive furnace pressure	1
	Safety fuel cutoff	1
	Smoke	1
	Flame failure	1
Motor drives		
Coal feeders	Overload	2
	Trip	2
Pulverizers	Overload*	2
Air preheater	Overload	1
	Trip	1
F-d fan	Overload*	1
I-d fan	Overload*	1
Dust-collector fan	Overload	1
	Trip	1
2400-v motors	Common trip	1
I-d fan coupling	High oil temperature	1

II: Master-Boiler Panel Alarms

Function	*Cause of Alarm*
Feedwater	Demineralization-system failure
	High- or low-level storage tank
	High-level heater
Boiler-feed pumps	No. 1 turbine drive, trip
	No. 2 motor drive, overload*
	No. 3 motor drive, overload*
Pressure-reducing valves, desuperheating stations	No. 1 high temperature
	No. 2 high temperature
Fuel oil	High temperature, pump suction
	Low pressure, header
	No. 1 pump motor, trip
	No. 2 pump turbine, start
Combustion power	115-v ac power failure
	125-v dc power failure
	Low air pressure
	Alarm power failure
26th St steam supply	Excess flow trip
House water service	Low pressure, east side
	Low pressure, west side
2400-v motors	Common trip

*2400-v motors

III: Boiler-Room Panel Alarms

Function	*Cause of Alarm*	*No. per Unit*
Coal feed		
Unit No. 2	No flow to feeder	2
Unit No. 3	No flow to feeder	2
Unit No. 4	No flow to feeder	2
Unit No. 2	Feed shear-pin failure	2
Unit No. 3	Feed shear-pin failure	2
Unit No. 4	Feed shear-pin failure	2
Feedwater	Low feedwater pressure	—
	Deaerating heater, low level	—
	Deaerating heater, high level	—
Condensate	High conductivity	—
	Collection-tank high level	—

Principal Controls Equipment

Panel fabrication ..... Panellit, Inc.
Combustion control, Smoot Electronic ..... Republic Flow Meters Co
Feedwater control ..... Copes-Vulcan Division Continental Foundry & Machine Co
Straight-line indicators ..... The Dickson Co
Control switches and indicating lights ..... General Electric Co
Ammeters ..... Weston Electrical Instrument Corp
Pneumatic recorders ..... The Foxboro Co
Steam-flow measurement ..... Bailey Meter Co
Superheat control ..... Leeds & Northrup Co
Oxygen analyzer ..... Hays Corp
Temperature recorder ..... Minneapolis-Honeywell Regulator Co
Smoke-density recorder ..... Leeds & Northrup Co
Water-level indicators ..... Bailey Meter Co
Desuperheater and prv controls ..... The Swartwout Co
Coal-scale counters ..... Stock Equipment Co
Selsyn indicators ..... Bendix Aviation Corp
Flame supervision, Fireye ..... Combustion Control Corp
Alarm system ..... Panalarm Products, Inc

From coast to coast, from large plants and small, from plant men and consultants, we've had requests for entry blanks.

How about you?

There's still time to enter . . .

THE Power AWARDS FOR

to encourage planning for future modernizations, and to recognize meritorious completed programs

■ Always a good idea, modernization has special importance now. The reasons are clear. We've just come through a period of heavy pressure on plant expansion, coupled with shortages of materials and equipment. Many plants that came out of the war years needing renovation still wait for it. And growing industrial competition will put an ever greater squeeze on power-service costs.

■ As POWER's editors travel the field they see many signs that progressive engineers are gearing their plants to meet this new situation. Aware of the need for paring their costs with up-to-date equipment and methods, power men are tackling the job of modernizing with enthusiasm and ingenuity—and are reaping the benefits.

■ Here's a movement of great and timely importance to America's power-service systems, a movement we believe in and want to encourage and foster. As briefly announced in our 1953 Mid-September *Modern Plant Handbook*, we plan awards to fan growing interest in modernization, to stimulate ideas that will help all engineers to bring their plants up to date, and to recognize those who have already done outstanding jobs.

YOUR OPPORTUNITY. If you have completed a modernization job during the past two years (calendar 1952 and 1953), here is your opportunity to have your engineering skill and judgment recognized. Through the pages of POWER the results obtained in your plant will be made known to your fellow engineers across the country. And plants selected for outstanding accomplishment will receive a citation testifying to that fact—a citation that may be proudly displayed for all to see.

WHO IS ELIGIBLE? Entries may be made for any type of plant — steam, diesel or hydro — in any service — industry, institution or utility. Small installations will receive the same consideration as large.

Modernization may involve the entire power-service system or any major part of it—boiler plant, generating equipment, electrical distribution, heating, air-conditioning, refrigeration, compressed-air or water supply systems.

BASIS OF JUDGING. POWER's editors, assisted by advisory experts, will do the judging, putting emphasis on the gains resulting from modernization and on the ingenuity with which problems were solved and obstacles

MODERNIZATION

overcome. Size and cost of installation will not influence judging; all will receive equal consideration.

WHO MAY SUBMIT ENTRIES? Most will come, of course, from power-service staffs, but consultants may enter for their clients. We will welcome suggestions and leads from anyone in the power field who knows of a meritorious modernization project.

EASY TO ENTER. To make it easy to tell us about what you've done, we've designed a simplified entry blank. By answering the streamlined questions on it, you can quickly give us the data we need about your program. For an idea of the kind of information wanted, and other pertinent details about entering, see the column at the right.

ENTER NOW. No matter how good a job you may have done, or how proud you may be of the results, you can't win an award for it unless you enter. So do it now. Then you'll have a chance to win concrete evidence of the worth of your accomplishments — recognition you, your top management and your staff will be proud of for years to come.

How to submit entries

1. Entries will be received from plants of any type, of any size, in any service, in which a modernization program was completed during the calendar year 1952 or 1953. Modernization may cover the entire power-service installation or any major part of it.

2. Entries may be made by any responsible member of a plant's power-service staff, or by a consultant for his client.

3. To enter, just say "I'd like a 1954 Modernization Award blank" and address your card or note to:

Modernization Award Committee
℅ POWER
McGraw-Hill Publishing Co, Inc
330 West 42nd Street
New York 36, N. Y.

4. The entry blank you receive will contain a series of streamlined questions designed to make it easy for you to tell us about your modernization job and its results.

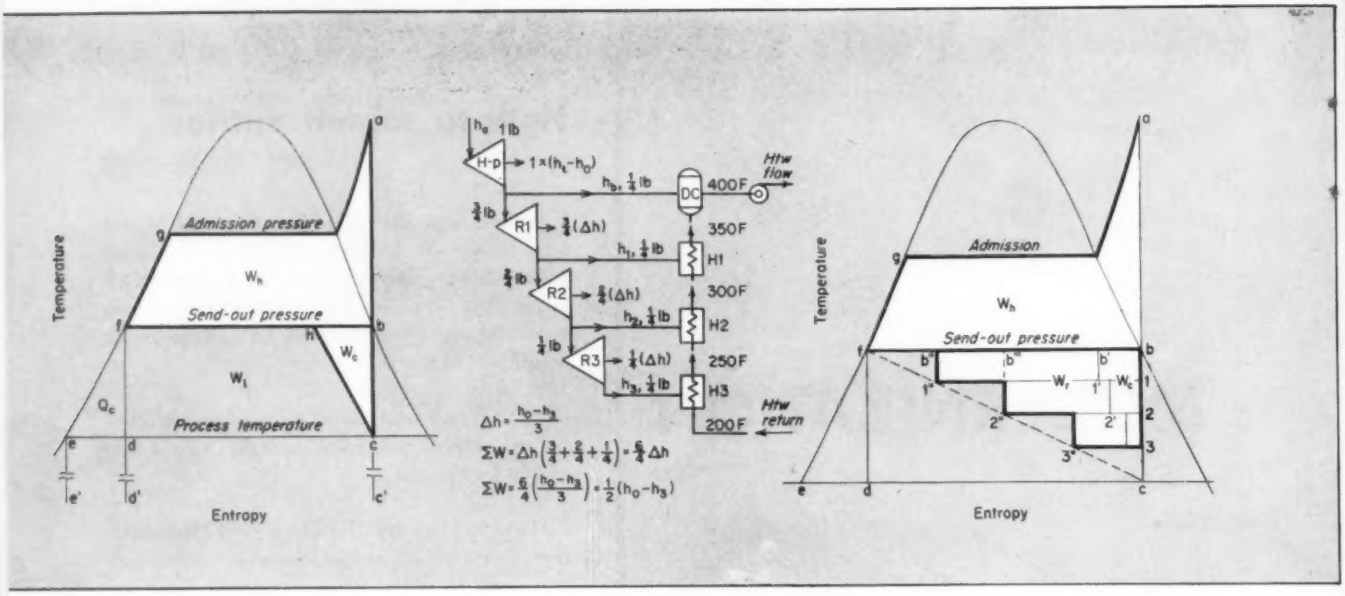
5. In general, the kind of information we ask for will tell us (1) what was modernized (2) the principal reasons for modernization (3) what results were obtained (4) the unique features of the job, and (5) what unusual or difficult problems were solved.

6. Entries will be received to May 15, 1954.

7. Announcement of award winners will be made in the 1954 Mid-September *Modern Plant Handbook* issue.

8. Arrangements for presentation of the awards will be made to suit the mutual convenience of the recipients and the POWER staff.

9. There is no set number of awards. It is our intention to recognize all plants that, in the opinion of the judges, have carried out modernizations of outstanding merit.



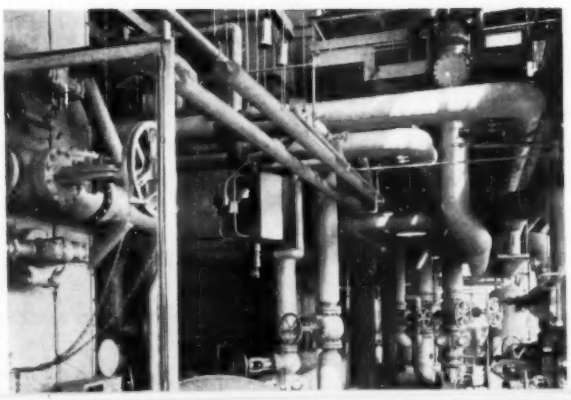
1 Temperature - entropy diagram for steam process-heat power cycle

2 Simplified htw regenerative process-heat power-cycle layout

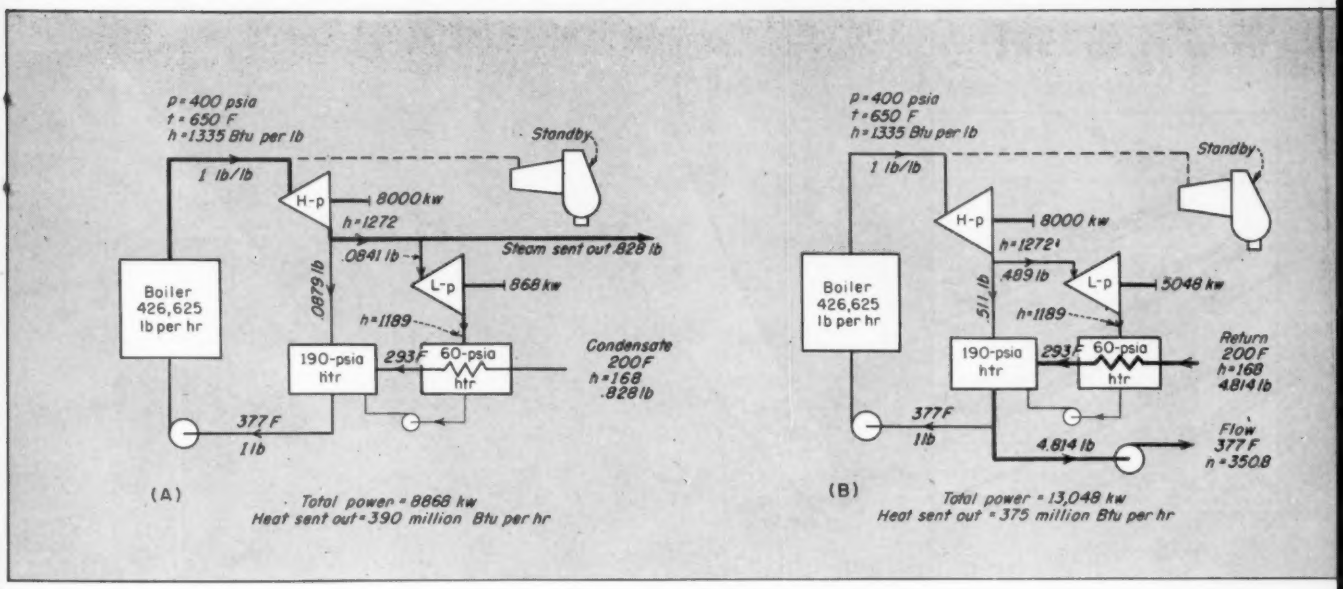
3 Temperature-entropy diagram for htw process-heat power cycle

With regenerative heating in steam plants or waste-heat recovery in gas-turbine installations, broad new fields are opening to plants requiring both process heat and power

Use High-Temperature Water Now to Step Up Efficiency, Produce More Power



By **PAUL GEIRINGER**, *Chief Engineer*
and **FLOYD HASSELRIIS**, *Applications Engineer*
American Hydrotherm Corporation



4 A: Arrangement of equipment for a typical steam process-heat power cycle. B: Hookup for a typical htw cycle

► WE DEFINE HIGH-TEMPERATURE water (htw) as water circulated above 250 F. Temperatures up to the critical can be used, but today's economics favors a maximum of 400 F for distribution systems with runs of more than a mile from the heat source. Lower temperatures are used for shorter runs. The higher the temperature at which htw is distributed, the smaller the volume circulated, and the smaller the pipe sizes required. Likewise, the lower the return temperature, the more economically can the plant be built.

Application. Htw is used directly or indirectly for space or process heating, generation of low-pressure steam or lower-temperature water. Centrifugal pumps circulate the htw through a closed circuit that all but eliminates makeup, water treatment and boiler blowdown. A plant in New Jersey serving several manufacturers has not renewed water in its system in 14 years. Only boiler blowdown is for inspection. System is internally clean and uncorroded.

Because flash, condensate and other losses are eliminated, htw plants run at 20% higher thermal efficiencies than equivalent steam plants. European engineers make widespread use of htw, and have done so for the last 25 years, Today, interest in htw is mushrooming in the U. S.

Of 42 district-heating plants in Europe, 36 use hot water. In four of these plants the water temperature is 320 F or higher. Eleven use water at above 240 F. The largest htw system in Europe has a heating capacity of 1500 million Btu per hr. Heat is obtained by condensing exhaust steam from power-producing turbines.

Htw in U. S. Process applications requiring fine temperature control and large industrial and district-heating installations are popular uses for htw in the U. S. today. Largest user is the U. S. Air Force. Almost all its large bases built or planned since World War II use htw. Installations range in size up to several hundred million Btu-per-hr capacity, with buildings as far as 1.5 miles from the heat source. Rutgers University recently installed a central htw plant feeding buildings one mile away.

Many industrial plants using htw for space and process heating have ticked off years of economical and satisfactory service. These installations prove that htw is an excellent heat carrier and frequently it is wise to depart from conventional steam systems in favor of htw.

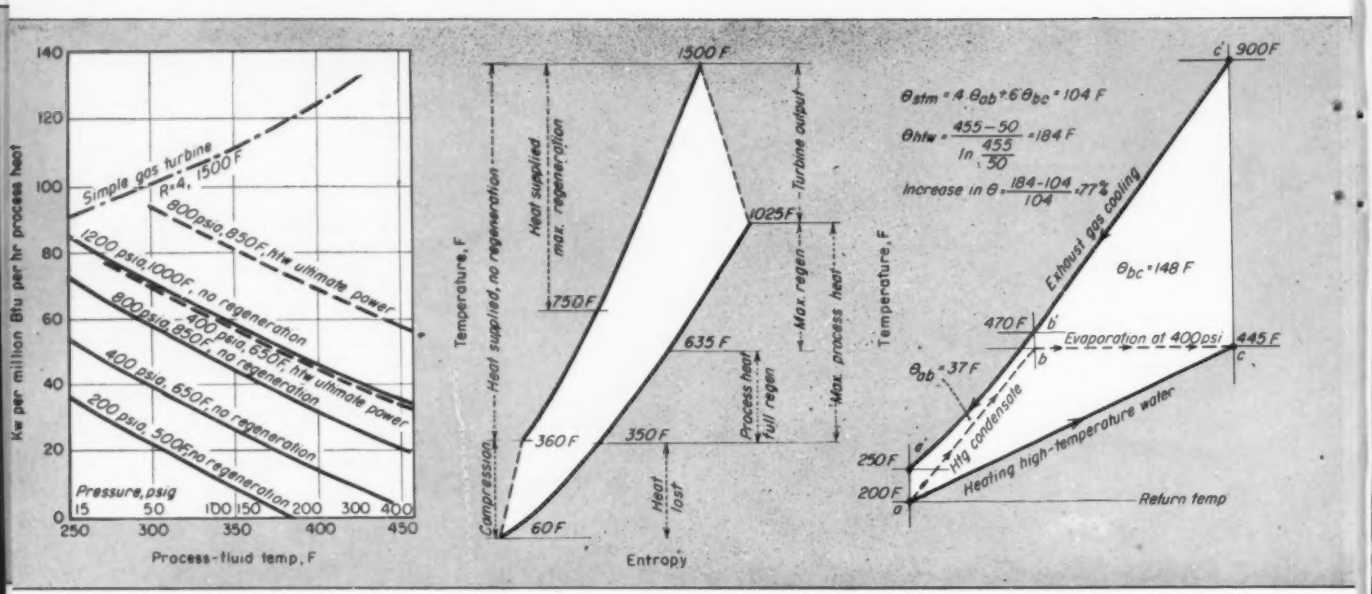
Plant Comparisons. In a steam plant run without using the heat in the exhaust, about 70% of the heat supplied by the boilers is removed and wasted during condensation. Heat rates lower than 9000 Btu per kwhr are seldom obtained, even in the most modern plants.

Superpressure plants are not expected to produce a kilowatt with less than 8160 Btu per hr, corresponding to a plant thermal efficiency of 42%. Theoretically, only 3413 Btu per hr are required to produce a kilowatt in a plant making full use of the exhaust heat. In practical plants it is possible to produce a kilowatt with as little as 4900 Btu per hr, an efficiency of 70%.

Plants with heat recovery suffer only boiler-stack losses, radiation and bearing friction losses. Even frictional reheat losses in the last stage of the turbine are recoverable from the condensate.

More on next page ▶

Air-field htw boiler room contains the circulating pumps, expansion tank and piping for delivery and return of the water to the distribution lines feeding the various areas that require heat



5 Performance curves for several cycles analyzed in the text of article

6 Temperature-entropy diagram for a typical gas-turbine cycle

7 Temperature difference along heating surface (x-axis) depends on fluids

Distribution. Steam or htw can be used to distribute recovered heat. Though in the past steam has been used almost without exception in the U. S., there are a number of reasons why htw should be seriously considered for heat recovery and distribution.

Thermal efficiency of htw-distribution systems is higher than that of equivalent steam systems. Water-treatment and corrosion problems are practically eliminated. The heat-accumulation capacity of the system reduces peak loads on turbines and boilers. Last but not least, htw plants with regenerative heaters produce far more power than equivalent steam power plants.

Losses. Distribution losses with htw are only 5 to 6%, as compared with 15 to 20% when steam is the carrier of heat recovered from a turbine. Only losses in a well-designed htw system are radiation and transmission from distribution lines. It is generally impractical and uneconomical to eliminate these losses from steam-distribution system.

Water Treatment. Steam systems commonly have high makeup, frequently 100%. Large makeup decreases condensate-line life.

By necessity, htw systems are designed as completely closed. There is little makeup. Steam is generated near the heat consumer and it is usually practical to return all or most of the condensate. Large quantities of makeup for the steam generator do not contaminate the htw system. Heat-exchanger surfaces are not fired, and are more readily accessible for cleaning. These advantages must be weighed against the cost of the heaters. Since piping and equipment are subjected to water of the same composition throughout the system, it is easy to maintain desired water conditions by proper treatment.

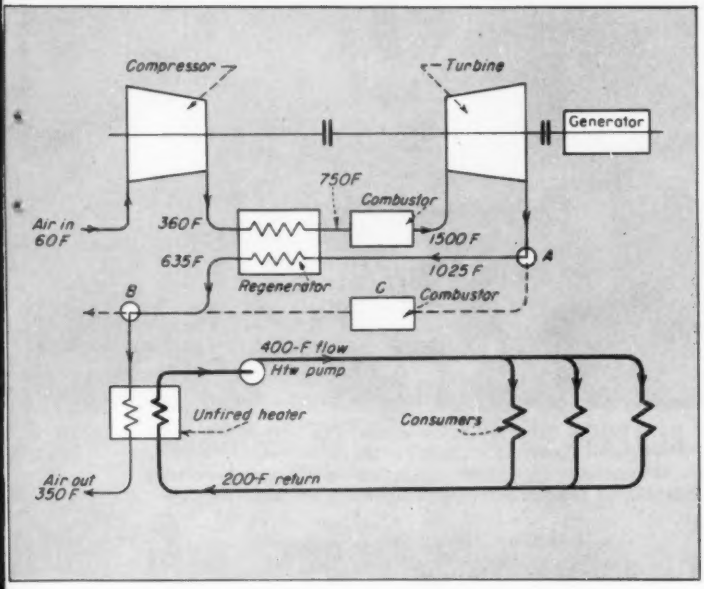
Heat Accumulation. Steam accumulators are widely recognized as convenient units for damping process heat swings to produce a more uniform load on boilers and turbines. Also, they store heat during periods of high power, low process demands, and vice versa.

Because htw has great heat-storage capacity, the large mass of water in the pipes serves as a heat accumulator. In a 200-million-Btu-per-hr htw system containing 1.5-million lb of water in 3 miles of piping, the design heating capacity can be maintained for 20 min when line drop is 100 F. Normal load of 75 million Btu per hr can be carried for one hour.

A similar 200-psi steam system with a 100-F drop to 40 psig carries a load of only 5-million Btu compared with 75 million Btu for htw. Steam system would serve load only about 4 min.

Heat-Power Cycles. We can evaluate the performance of process heat-power cycles by setting up a ratio of power output to the heat sent out. This ratio is the coefficient of performance (*cop*) of the cycle. The higher its value, the more effective the cycle. Then *cop* for a steam cycle is determined by the turbine admission pressure and tempera-

Careful study of process-heat and power demands shows which hookup is best for a given plant



8 Hookup for gas turbine and htw heaters for process heat, power

ture and by the send-out or exhaust pressure in a simple nonregenerative hookup.

Rating of turbine largely determines admission pressure and temperature. In the 15,000- to 20,000-kw range 400 psi is a common inlet pressure. Capacities of 30,000 to 50,000 kw step the inlet pressure up to 600 to 800 psi.

Exhaust pressure selected depends largely on economics. In general, use the lowest exhaust pressure that will meet (1) process-temperature requirements, and (2) economic factors dictated by distribution-system cost.

For example, a plant needing process heat at 200 F might have an economic send-out pressure of 50 psig (300 F) because at a lower pressure the distribution piping and equipment might be excessively large and costly. High send-out pressures give lower power output and a lower cop. Experience shows that a send-out and return temperature difference of 100 to 200 F gives optimum performance. Where regeneration is incorporated in a htw cycle, a much higher *cop* is obtained than with a similar steam system.

Cycle Analysis. Fig. 1 shows the conventional temperature-entropy (t-s) diagram for a process heat-power cycle. Area *abfga* represents the power output W_h with admission condition *a* and the chosen send-out pressure. Heat that can be sent out by this cycle is represented by area *bc'd'fb*, which we call Q_p. Area *bcefb* shows the power that could have been produced if the send-out pressure had been reduced to the process temperature. The work W_l, which is sacrificed for economic considerations, ranges from 20 to 150% of the power W_h, depending on the temperature limits of the cycle. So our problem is: How can we invade area W_l without uneconomic expenditures?

Large process-steam plants, such as the Waterside Station in New York, find it worthwhile to resort to regeneration of condensate or makeup water. But the amount of power obtained has not been great enough to justify the required equipment in plants below a certain size.

Theoretically, the amount of additional power that can be gained by regeneration of condensate in a steam-process plant can reach the power equivalent of the heat added to the condensate when a large number of heating stages are used. The maximum power can be represented by area *defd* in Fig. 1. Following the more conventional method, area *bchb* represents maximum power. This is a relatively minor improvement in cycle *cop* because the ratio of heat given up by process steam to sensible heat that can be added by bled turbine steam for heating condensate or makeup is large.

Sensible heat that can be added, area *fd'e'ef*, varies from 7% at 25-psig send-out pressure to 20% at 300-psig of the heat given up by the steam (area *bc'd'fb*). Since this unfavorable ratio determines the power we can obtain by regeneration, and is poor because we are using a vapor for heating, a liquid appears to be a better heat-distributing medium.

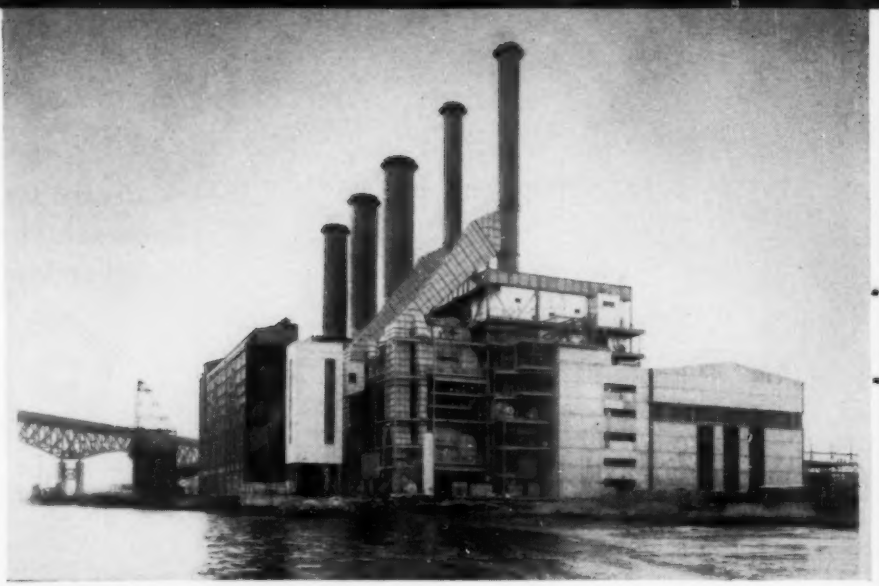
Htw Process Cycle. Fig. 2 traces one pound of steam through a htw regenerative heat-power cycle. Four heating steps, each 50 F, increase water temperature from 200 to 400 F. One direct- and three indirect-contact heaters are used. Since each heater takes about 0.25 lb of steam, the first regenerative turbine *R1* receives only 0.75 lb; *R2*, 0.5 lb; *R3*, 0.25 lb. Work produced by these will be 0.5 times the over-all enthalpy drop (h_b-h_3) because each turbine receives an average of 0.5 lb of steam.

Fig. 2 neglects the power output from regenerating condensate drained from the heaters. However, it can be shown that making this correction leads to the same result; that the work produced by regeneration will be one half the over-all enthalpy drop of the cycle used.

Temperature-entropy diagram, Fig. 3, is for a htw process heat-power cycle with three stages of regeneration. Area W_c shows power from condensate regeneration. Output of turbine *R1* is area *b11"b"b*. Heavily outlined area shows total power obtained by regeneration of htw and condensate. Adding an infinite number of stages permits us to approach area *cfbc*, representing half of area *bcdfb*, which we previously gave up as unavailable for economic reasons. Even with only one stage of regeneration we obtain area *b22"b"b*, half the ultimate power gain. (*Continued on p* 212)

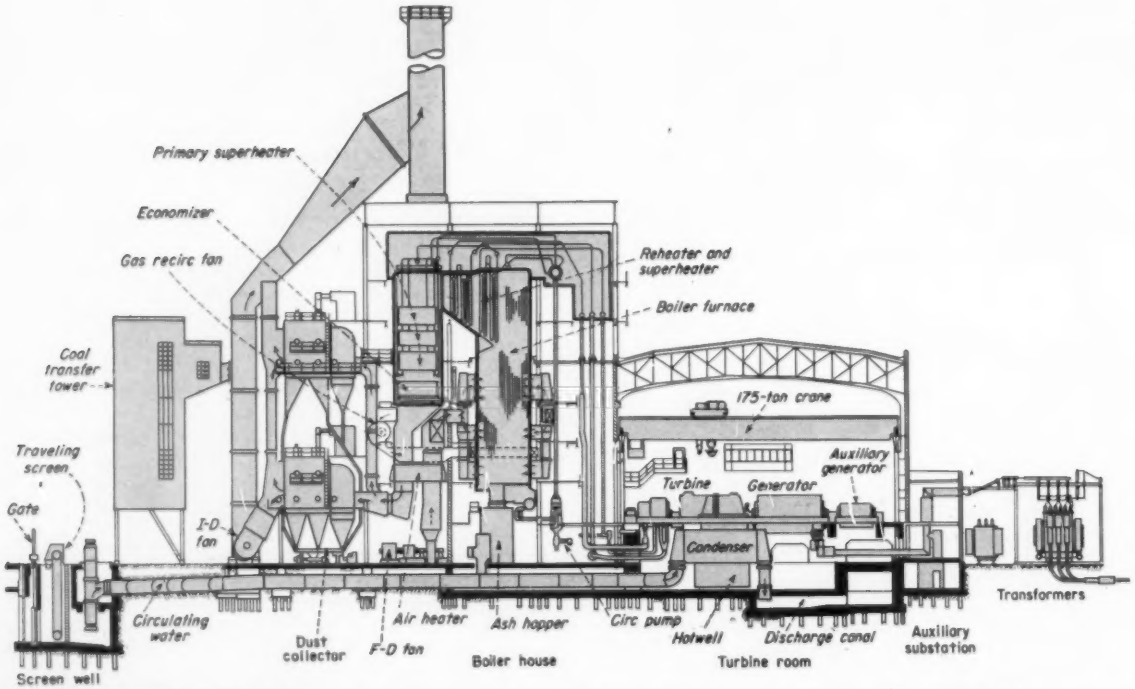
• Take *Power's* picture tour through new section of Kearny Generating Station to see how this plant puts the latest engineering designs to work.

• With this addition of two 145,000-kw units to its system, Public Service Electric and Gas Co, N. J., almost doubles its postwar capacity

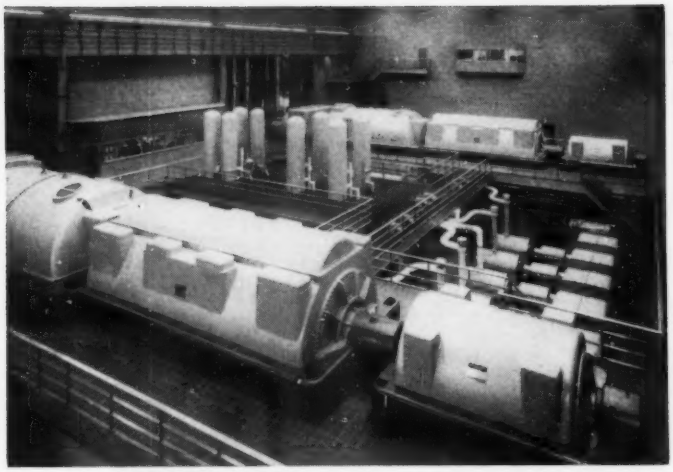


SEMI-OUTDOOR BOILERS cut building costs and still provide necessary cover for critical parts. Each boiler drum and associated three steam headers are enclosed in boiler casing. Turbine-generators and auxiliaries, with boiler burner front and furnace bottoms, are housed

New Reheat Turbines at Kearny: First to Use 1100-F Throttle Steam

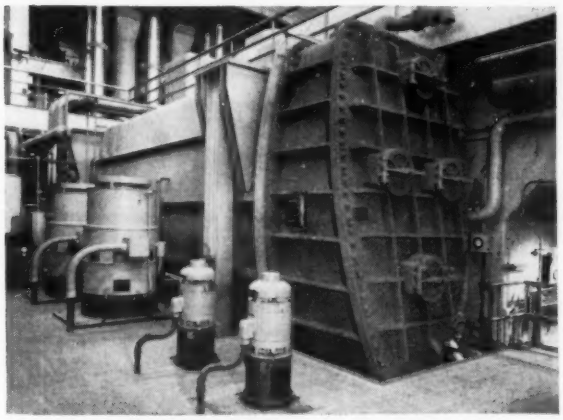


STATION CROSS SECTION shows how compact layout keeps main steam leads to turbines relatively short. This is done by placing pulverizers between the two boilers instead of between the boilers and turbines. Control room is on operating-floor level in center of a square made by the two boilers and two turbines. Unit system hookup of one boiler to one turbine without connections between units, raises generating-station reliability

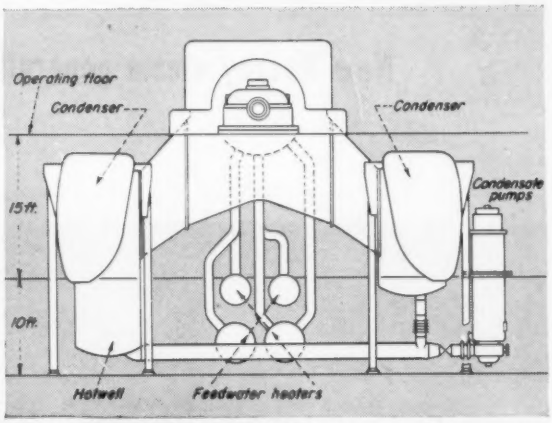


TURBINE-ROOM setup uses main crane for dismantling main units and vertical feed heaters on operating floor as well as boiler-feed pumps and hydraulic couplings on lower level between shaft-house generators

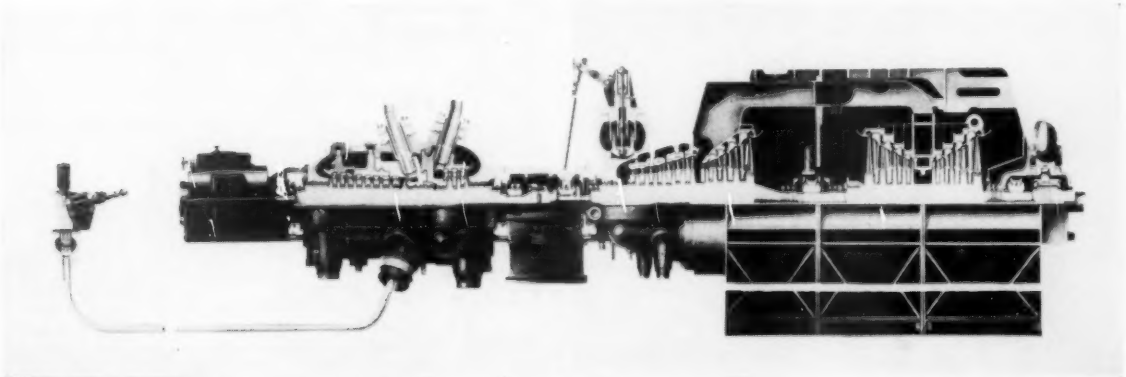
CIRCULATING-WATER PUMPS, *left*, are vertical, mixed-flow type. Four pumps supply 50,000 gpm each against 19-ft head. Traveling water screens, *right*, remove debris before it can enter pumps



STEAM CONDENSERS are single-pass deaerating type with 10,000-gal hotwell. Unit has two sections of 35,000-sq-ft surface each. Two heater-drain pumps, two condensate-booster pumps stand beside the condenser on the lower operating level

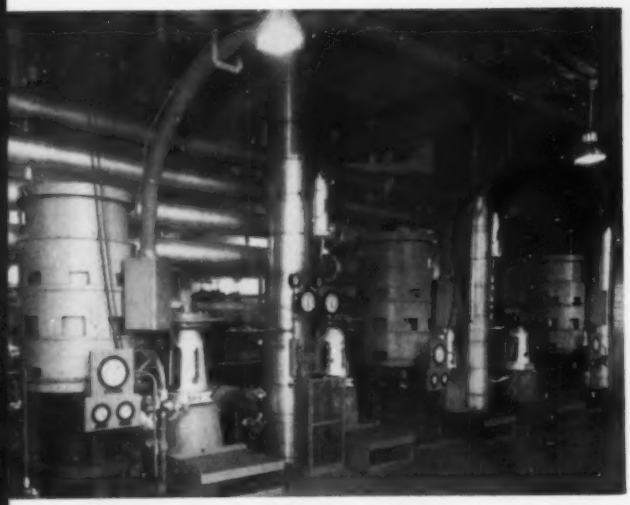


SIDE TURBINE EXHAUST, instead of bottom, cuts distance between upper, lower operating levels to 15 ft. Saving from reduced building volume: about $300,000. Column condenser supports permit horizontal thermal expansion, provide vertical restraint

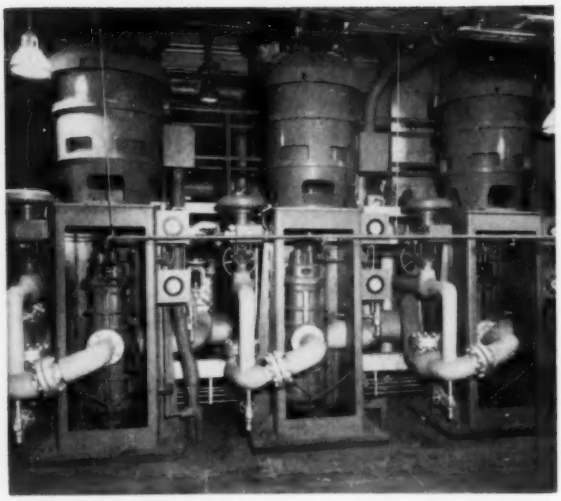


REHEAT TURBINES use 1100-F 2350-psig steam exhaust at 1.5 in. Hg. Two 145,000-kw units run at 3600 rpm. Steam enters center of h-p cyl, flows left, exhausts to reheater. Reheated 1050-F steam re-enters h-p cyl to flow through three stages before crossing to intermediate reheat cyl. Setup permits lower-temperature materials in reheat section. Eight bleed points supply steam to heat feedwater. The turbine drives main and shaft house generators

More on next page ▶

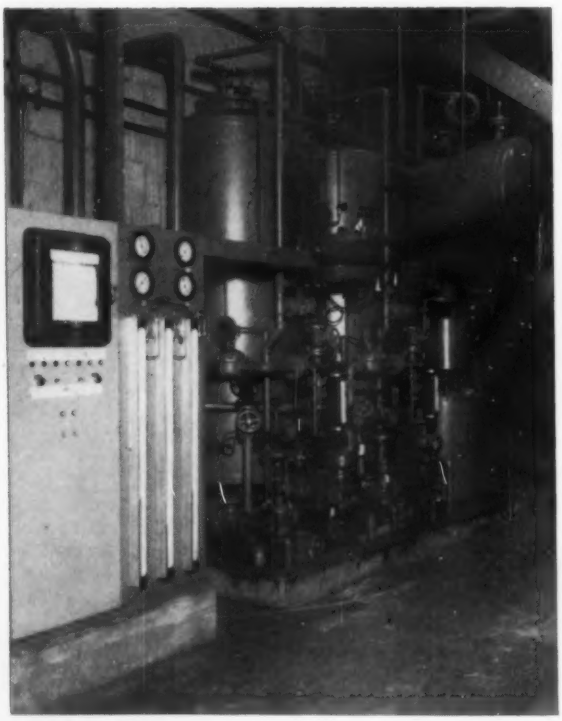


BOILER CIRCULATING PUMPS handle 7300 gpm each at 40-psi differential pressure. Downcomers with reflective insulation feed suction line below floor. Three pumps per boiler, one a standby

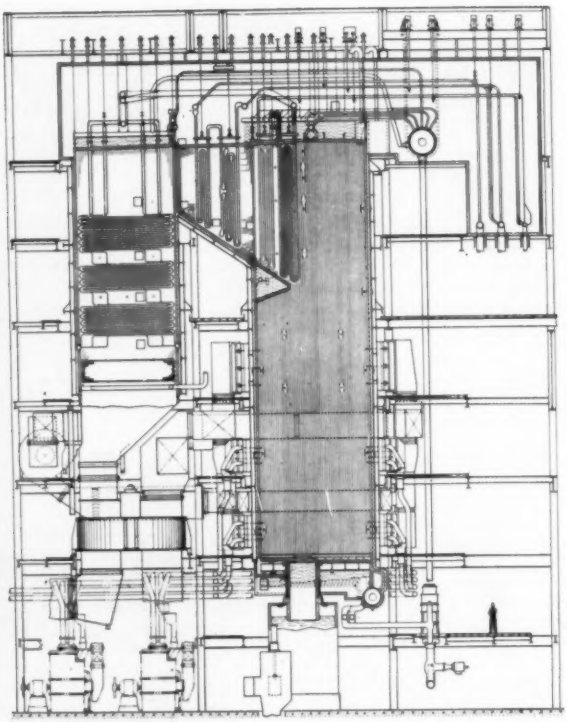


FUEL-OIL PUMPS screw type, supply 24 burners on each boiler when set up for oil firing. Diaphragm valves, to left of each unit, control fuel-oil recirculation. Pumps supply 180 gpm at 1865-ft total head

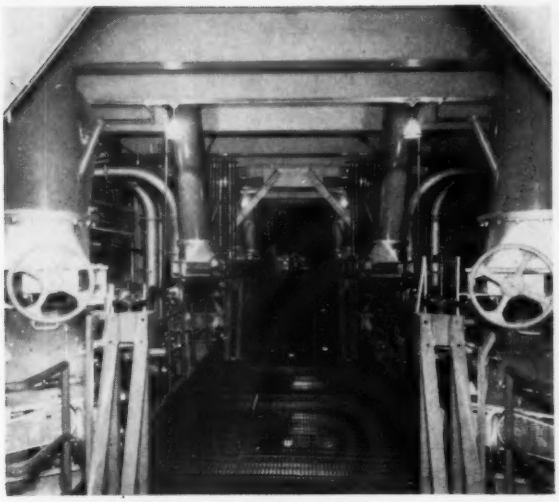
New Kearny steam generators use: Controlled circulation
Pressurized furnace
Flue-gas recirculation



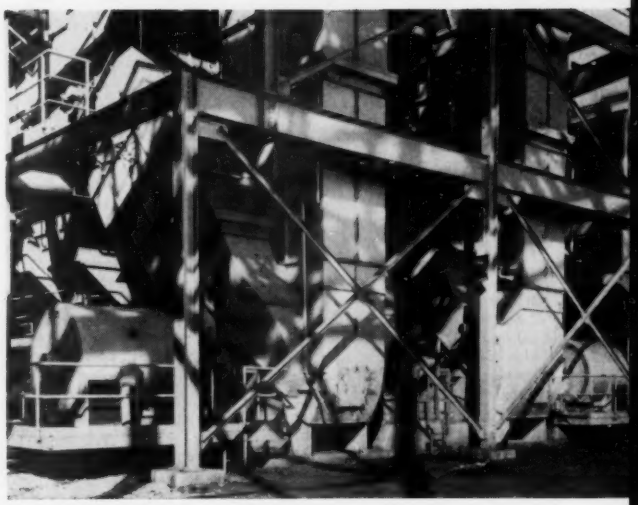
DEMINERALIZER removes mineral salts from makeup water. Two-tank unit can handle 50 gpm, requires only periodic regeneration. Demineralized water compares favorably with distilled. Less operating cost



CONTROLLED-CIRCULATION BOILER continuous capacity is 955,000 lb per hr. Circulating pumps below upper drum, supported on suction header, eliminate costly expansion loops



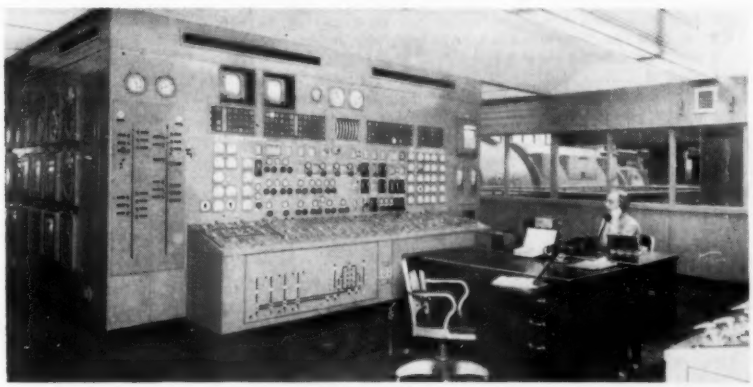
COAL-PULVERIZER FEEDERS are accessible from common platform between two boilers. Four pulverizers per boiler are Raymond bowl type with integral exhauster. Capacity, 18 tons per hr each



INDUCED-DRAFT FANS, outdoors at ground level, permit emergency suction firing. Pressurized boilers use only f-d fans. F-d fans use variable-speed hydraulic coupling control, i-d fans damper control

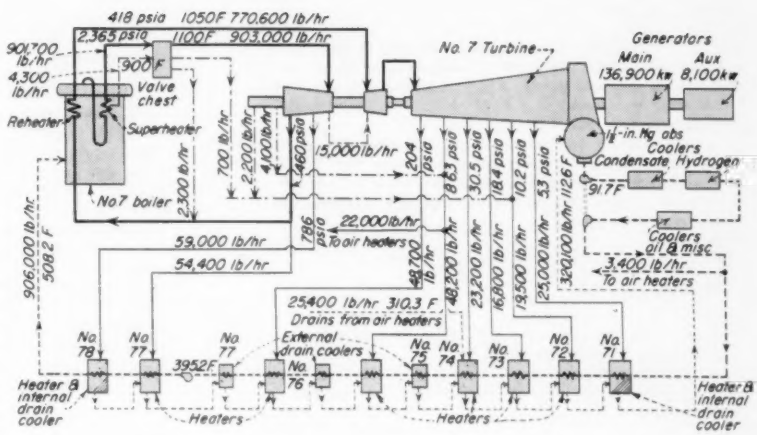
CENTRAL CONTROL ROOM

Soundproofed and air-conditioned. From his desk operator sees only instruments needed to operate plant. The recording instruments are on panels in control-room wings. Closed-circuit television views combustion conditions in one boiler. TV unit for second boiler will be installed after trial on first. Panel area for one unit covers 350 sq ft



UNIT HEAT BALANCE

Eight feedwater heaters serve each unit. All heaters flash their drains to the next lower-pressure heater, either directly or through the drain coolers. The lowest-pressure heater flashes to the condenser to join main feedwater flow. Boiler feed pumps connect between the sixth and seventh feedwater heaters. The plant heat rate equals 8830 Btu per kwhr



PRINCIPAL POWER PLANT EQUIPMENT

Kearny Generating Station—Units No. 7 and 8, Public Service Electric and Gas Co, N. J.

STEAM-PRODUCTION EQUIPMENT:

Steam generators, 2 ..... Combustion Engineering Inc
955,000 lb per hr continuous, 1,055,000 lb per hr for 4 hr, 2350 psig, 1100 F/1050 F reheat, press. or suction furnace operation. Reheaters: 2, convection, 14,344 sq ft heating surface, temp control by spray desuperheaters. Superheaters: 2, convection, 12,900 sq ft heating surface in high-temp section, 81,000 sq ft in low-temp section, superheat control by desuperheaters. Economizers: 2, continuous, hor tube, counterflow, 28,300 sq ft heating surface, 515-F inlet water, 552-F outlet. Desuperheaters: 8, steam-assisted spray type for superheaters, pressure-spray for reheaters

Air heaters, 4 ..... Air Preheater Corp
Ljungstrom regenerative, vertical shaft, 67,500 sq ft

Boiler-water circulation pumps, 6 ..... Pacific Pumps, Inc
Vertical, centrifugal, single-stage, 7300 gpm at 154-ft total head, includes one spare per boiler

Fans, 4 f-d, 4 i-d ..... American Blower Corp
F-d fans: variable speed, hydraulic coupling, 152,800 cfm at 80 F and 40.37-in. wg, 1130 rpm maximum. I-d fans: inlet louver damper control, 255,700 cfm at 327 F and 23.7-in. wg, 860 rpm

Gas-recirculation fans, 4 ..... Sturtevant Div, Westinghouse Elec Corp
53,500 cfm at 683 F and 14.25 in. wg, 880 rpm, radial type

Soot blowers ..... Diamond Power Specialty Corp
Automatic, sequential, pneumatically operated, air blowing, retractable units operate on 250 psi, air-puff units on 350 psi. Furnace: 26 retracting. Superheater and reheater: 14 retracting, 2 telescopic. Economizer and low-temp superheater: 6, rotating air puff. I-d duct: 2, stationary, air puff

Air-heater soot blowers, 2, single nozzle ..... Air Preheater Corp

POWER-GENERATING EQUIPMENT:

Turbine-generators, 2 ..... General Electric Co
145,000-kw, 3600 rpm, 2350 psig, 1100 F/1050 F reheat, 1.5-in.-Hg backpressure, tandem-compound triple-flow, reheat, side exhaust, 20,000 v, wye connected. Main generator exciters: 3, 400-kw, 375 v, 900 rpm, self-excited, includes one spare. Aux generators: 2, 10,000-kw, 4160 v, 3600 rpm, wye connected. Aux generator exciters: 3, 45-kw, 250 v, 900 rpm, includes a spare

Condensers, 2 ..... Foster Wheeler Corp
Each consists of two 35,000-sq-ft units, single-pass, deaerating, 10,000-gal hotwell, seamless drawn aluminum brass and aluminum bronze tubes

Circulating-water pumps, 4 ..... Foster Wheeler Corp
Vertical, mixed-flow, bottom suction, 50,000 gpm at 19-ft total head, 390 rpm

Vacuum pumps, 4 ..... Kinney Mfg Co
Single-stage, rotating plunger, 550 cfm, 1.0 in. Hg, 400 rpm

Turbine-oil conditioners, 2 ..... Bowser Inc
Dry type, 629-gal storage, 1080 gpm filtering capacity

FEEDWATER EQUIPMENT:

Condensate-booster pumps, 5 ..... Worthington Corp
Vertical, centrifugal, 5-stage, re-entry type, condensate element 1325 gpm at 226-ft total head, booster element 1295 gpm at 945-ft total head, 1150 rpm, includes one uninstalled spare

Boiler-feed pumps, 5 ..... Worthington Corp
Horizontal, centrifugal, 9-stage, barrel, variable speed, hydraulic coupling, 1380 gpm at 6650-ft total head, 3465 rpm full-load speed, includes one spare

Feedwater heaters, 16 ..... Foster Wheeler Corp
No. 4, 5, 6, 7 and 8: vertical, closed, shell and U tube, 2-pass, No. 8: integral drain cooler, No. 5, 6, 7: external drain coolers, No. 1, 2, 3: hor, closed, shell and U-tube, No. 3: 2-pass, No. 1 and 2: 4-pass, No. 1: integral drain cooler

Condensate coolers, 3
Condenser Service and Engrg Div, Consolidated Products Co
Two units cool 900,000 lb per hr of condensate from 115 F to 95 F, hor, shell-and-tube, single-pass, 85-F salt water counterflow in tubes, 5200 sq ft surface. One unit to cool 100 gpm of condensate to 100 F ahead of demineralizers

Demineralizers ..... Illinois Water Treatment Co
Two 50-gpm tanks to treat condensate makeup

COAL EQUIPMENT:

Pulverizers, 8 ..... Combustion Engineering Inc
18 tons per hr, Raymond bowl, pressurized, integral exhauster, pulverizing 75% through 200-mesh screen

Pyrites conveying systems, 8 ..... United Conveyor Corp
One per pulverizer, 15 tph, 450 gpm salt water at 100 psig

Weightometers, 2 ..... Merrick Scale Mfg Co

Magnetic separators, 2 ..... Dings Magnetic Separator Co

Redler conveyors, 7 ..... Stephens-Adamson Mfg Co
Four feeders from bunkers to belt conveyors: 150 tph, 19-in, hor, over and under arr. Two, each serving four silos: 165 tph, 19-in, hor, over and under arr. One, serving eight silos: 165 tph, 19-in, hor, closed circuit arrangement

Belt conveyors, 4 ..... Robins Engineers Div, Hewitt-Robins Inc
Two 30 in. wide, 270 ft long, 155 tph. Two, 30 in wide, 103 ft long, 160 tph

Coal valves, 32 ..... Stock Equipment Co

Ash system ..... The Allen-Sherman-Hoff Co
Two ash-storage hoppers per boiler, 60,000-lb slag cap, sump tank, clinker grinder, jet pump

DUST-HANDLING EQUIPMENT:

Dust collectors, 4 ..... Western Precipitation Corp
Integral Multiclone-Cottrell, 396 cast-iron tubes per Multiclone unit, 20 electrode curtains per Cottrell, 24 dust hoppers, 3-in. wg draft loss through precipitators at 460,000-cfm gas flow

Dry-dust pumping systems, 2 ..... Fuller Co
25 to 28 tph flyash each, Fuller-Kinyon, to pump dust to storage bin

Wet-dust handling system ..... The Allen-Sherman-Hoff Co
4x6 hydrovactor requiring 710 gpm water, 2 windswept valves

Flyash collectors, 4 ..... American Blower Corp
For gas recirculation system, multitube mechanical type, 0.6-in. wg draft loss at 60,000 cfm

Conveyors, 6 ..... Stephens-Adamson Mfg Co; Link Belt Co

INSTRUMENTS AND CONTROL SYSTEMS:

Combustion control system ..... Hagan Corp

Fuel-oil press. control ..... Hagan Corp

Three-element-type feed control ..... Bailey Meter Co

Superheat and reheat temp control ..... Bailey Meter Co

Temperature controls ..... The Swartwout Co

Water-level controls ..... The Swartwout Co

Boiler meters ..... Bailey Meter Co

Miniature indicators and draft gages ..... Bailey Meter Co

Multipoint temp recorders ..... Leeds and Northrup Co

Conductivity recorders ..... Leeds and Northrup Co

Boiler-drum-level gage glasses ..... Diamond Power Specialty Corp

Television furnace viewer ..... Diamond Power Specialty Corp

Ashcroft pressure gages ..... Manning, Maxwell & Moore, Inc

Sight-flow indicators and water level gages ..... Ernst Water Column and Gage Co; Yarnall-Waring Co

Indicating thermometers ..... Taylor Instrument Co's

Liquid-level controllers ..... Moore Products Co; The Swartwout Co; Fisher Governor Co

Oxygen recorders for combustion guide ..... Hays Corp

Boiler performance indicators ..... Panalarm Products, Inc

MISCELLANEOUS EQUIPMENT:

Fuel-oil heaters, 3 ..... The Griscom-Russell Co
Straight-tube, fixed-bundle, oil inside tubes, heat 180 gpm from 100 to 225 F with steam at 350 psig, 500 F

Air compressors, 4 ..... Fuller Co
Three units: hor, rotary, 2-stage, 1592 cfm, 125 psig, 575 rpm, 2 for soot blowers, one for service air. One unit: hor, rotary, single-stage, 603 cfm, 27 psi for dust system

Air compressors 5 ..... Ingersoll-Rand Co
Two units: hor, duplex, single-stage, reciprocating, 1500 cfm, 500 psi, 300 rpm, booster air for soot blowers. Three units: hor, carbon-ring, single-stage, 300 cfm, 80 to 100 psi, 300 rpm, control air

Control air dryers, 3 ..... C M Kemp Mfg Co
Dual-tower, silica-gel desiccant, 300-cfm air

Heater drain pumps, 4 ..... Worthington Corp
Vertical, centrifugal, 2-stage, 800 gpm, 36-ft total head, 1170 rpm

Fuel-oil pumps, 3 ..... Quimby Pump Div, Warren Steam Pump Co Inc
Vertical, screw type, 180 gpm, 1865-ft total head, 1150 rpm

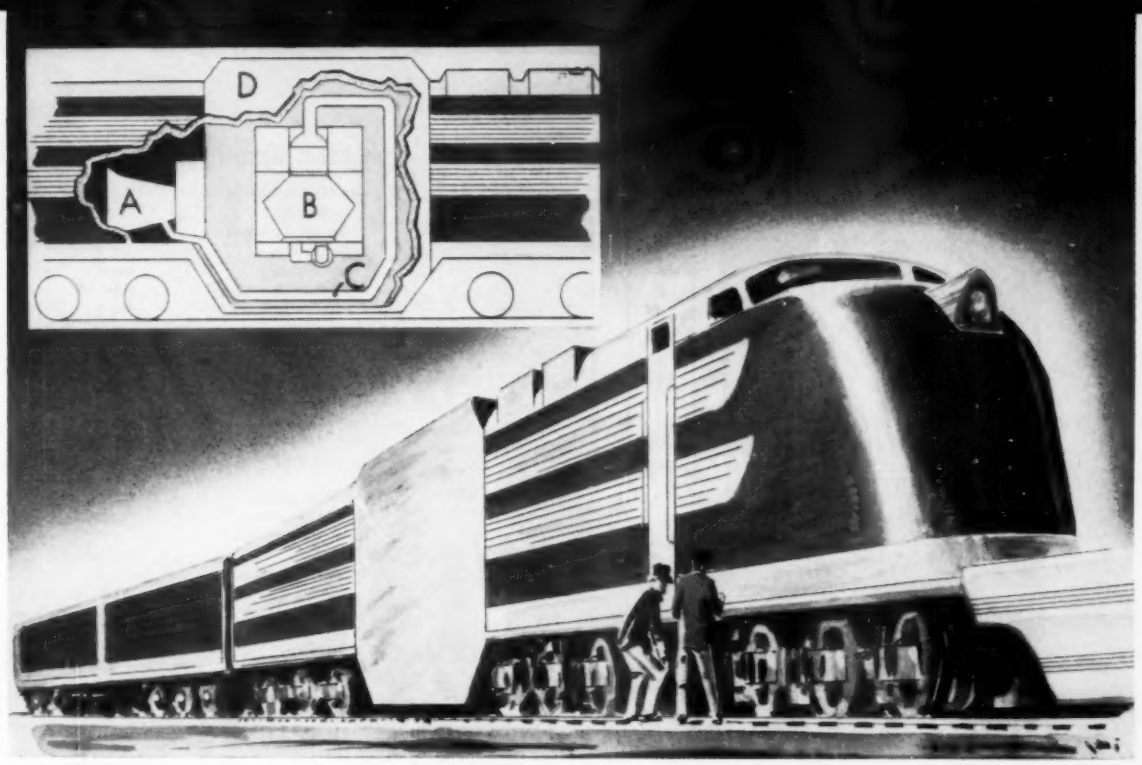
Station power transformers, 4 ..... Allis-Chalmers Mfg Co
9000 kva, 13.2/4.16 kv

Auxiliary generator leads ..... Westinghouse Electric Corp
Segregated phase, 2000 amp, 7500 volts

Auxiliary power switchgear ..... Westinghouse Electric Corp
High: metalclad, 5 kv. Low: 220, 440 v ..... I-T-E Circuit Breaker Co

Motors ..... Allis-Chalmers Mfg Co; General Electric Co; Westinghouse Electric Corp

Builders ..... United Engineers and Constructors Inc



ARTISTIC LICENSE pictures steam going directly from "soup" in *B* through pipe *C* to turbine. See text for the actual setup

One pound of U235 fuel per month 'burned up' in 'water boiler' would maintain normal operation of proposed...

7000-Hp Atomic-Powered Locomotive

► AN ATOMIC-POWERED LOCOMOTIVE—a 7000-hp, 160-ft-long, articulated giant, "burning" one pound of atomic fuel per month—is now technically possible, nuclear physicists at the University of Utah recently announced. But the first unit would cost $1,200,000, with nobody eager to step up and pay the cost.

Dr Lyle B Borst, Director of the University's research program, presented the *Feasibility Study* at a conference attended by 40 railroaders, motive-power experts and locomotive parts builders.

Until recently locomotives have been viewed as one of the most unlikely applications of atomic power, but Dr Borst hopes the atoms will ride the rails in the not too distant future.

Despite much skepticism among the railroad and motive-power people, W M Keller, director of Mechanical Research for American Railroads, announced that the Borst *Feasibility Study* will get a searching analysis by the Association of American Railroads' own committee on atomic power development projects.

This Utah University study, conducted by graduate-student physicists with University funds, was carried out in one year with technical advice from General Motors, Commonwealth Edison, Babcock & Wilcox, Trane, General Electric, Westinghouse, and McQuay, Inc.

Uses Sulfate of U235

The suggested locomotive, outlined in a general way by Dr Borst and his colleagues, is powered by a "homogeneous thermal" reactor of the "water boiler" type. Heat source of the proposed locomotive is a "soup" of uranyl sulfate (sulfate of U235) dissolved in water. As the U235 atoms fission in a controlled chain reaction, the heat self-generated in this soup is transferred to ordinary water in 10,000 small tubes passing through the soup. Steam thus generated drives a turbine geared to four dc generators.

Although the heart of the proposed reactor is only 2x3x3 ft, its massive radiation shield weighs 200 tons.

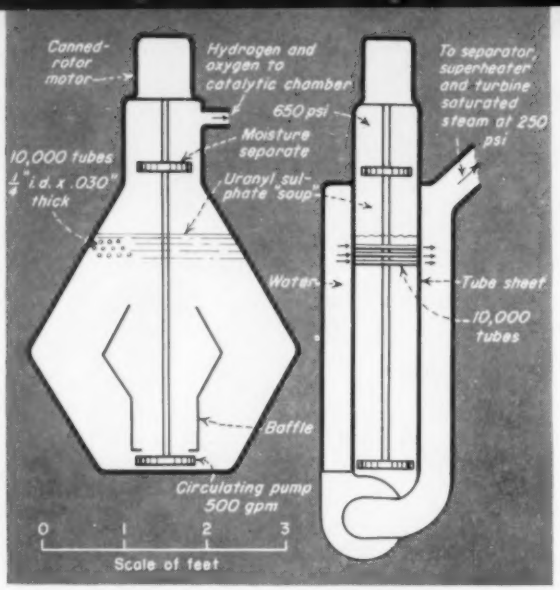
In Dr Borst's opinion the atomic locomotive could compete with present diesel locomotives under average operating conditions when U235 costs less than $7 per gram (that is, $3200 per pound).

Under specially favorable conditions (long-haul, high-speed freight) he thought it might be competitive at any price under $25 per gram ($11,400 per pound). He estimated maintenance costs at $50,000 per year.

One Pound U235 per Month

Fuel consumption would run about one pound of U235 per month under average operating conditions. Since the first cost of the atomic locomotive would be much higher than its equivalent in diesel locomotives, the atomic fuel must cost much less than the equivalent diesel oil if atom motive power is to be competitive.

Granted the lower cost of the atomic fuel, the best showing would be made with an atomic locomotive of high-pow-



SCHEMATIC of the "water boiler." Hexagonal center section, *left*, is the "homogeneous" thermal reactor, powered by U235

Table I: Operating Conditions

Reactor heat generation, continuous	30,000 kw
Steam press., saturated	250 psi
Reflector temp	405 F
"Soup" temp	460 F
Exhaust press.	6 in. Hg
Exhaust saturation temp	140 F
Steam flow	120,000 lb/hr
Turbine power, continuous	8000 hp
Efficiency estimate	20%
Auxiliary power	1000 hp
Power for traction	7000 hp
Turbine speed	6000 rpm
Generator speed	1000 rpm
Heat to radiators	70,000,000 Btu/hr
Water flow through radiators	5000 gpm
Air flow through radiators	10,000,000 lb/hr
Refuel	3 to 6 times a yr

Table II: Reactor Characteristics

Power	30,000 kw
U^{235}	19.8 lb
UO_2SO_4 weight	30.6 lb
H_2O required	535 lb
Vessel thickness	11.8 in.
Net volume of 10,000 tubes, ¼ in. ID	3.36 cu ft
Weight of moderator in tubes	178 lb
Fraction of moderator in tubes	1/3
Volume of 387-lb "soup"	6.2 cu ft
"Soup" plus tube's outside vol	11.7 cu ft
Area: hexagonal face of vessel	11.8 sq ft
Side of hexagon	25.6 in
Tube spacing, triangular	0.45 in.
Distance between tubes	0.134 in.
Tube surface	806 sq ft

er, operating almost continuously at high speed on long hauls.

The turbine, driven at 6000 rpm by saturated steam at 250 psi, would generate 8000 hp continuously, with overload capacity up to 10,000 hp. To avoid overheating the reactor these overloads could be used only for short spurts. Deducting 1000 hp for auxiliaries and losses leaves a normal net motive power of 7000 hp. at the axles.

The tentative design gears the turbine to four 1000-rpm generators supplying direct current to the driving motors.

Turbine exhausts to condenser at 3 psia. Recirculated condensing water is cooled by air-cooled fin-walled radiators in the trailer unit.

A heavy-duty bridge truss distributes the weight of the 200-ton radiation shield to 12 traction axles.

Boiler Described

Heart of the proposed reactor is a relatively small vessel with two parallel hexagonal flat sides. The recipe for the self-heating uranyl sulfate soup in this "kettle" is 30.6 lb of the uranyl sulfate (containing 19.8 lb of U235) dissolved in 357 lb of ordinary water. The water serves to hold the uranium salt in solution, to transfer the heat generated and also as a portion of the "moderator" required to slow down the flying neutrons to the so-called "thermal" speeds necessary for the chain reaction.

Extending between the flat hexagonal sides are 10,000 very small tubes containing the water for steam generation. This water also counts as part of the moderator. The upward extension of this inner vessel, as pictured, allows space for vapor and expansion.

Hydrogen and oxygen produced by the radioactive disassociation of the water in the soup must be continuously removed, then recombined to water (by a catalyst) and returned to the soup. At full load, heat thus obtained by the recombination of hydrogen and oxygen to form water (equivalent to about 500 kw) might some day be used to superheat the steam, the report suggests.

Power level is controlled by the perforated sheet baffles and control rods, both of neutron-absorbing boron steel.

The approximately 20 lb of U235 in the charge represents only about 10% excess reactivity, so refueling would be necessary after 2 lb have been consumed—about every two months in normal operation. This refueling would be a difficult operation, necessarily performed in a special plant by remote control.

A chemical processing plant might be included, or the spent fuel might be shipped elsewhere for separation of the unspent U235 from the fission products.

The control rods must be so designed that a wreck or a sudden emergency stop will throw them in and so shut down the reactor.

Radioactivity prohibits maintenance inside the reactor shield, regardless of the length of the cooling-off period. The reactor must be so designed that failures in this area are extremely improbable. Reactor failure would put the locomotive out of commission for months—even years.

The need to replace the reactor must be avoided at all costs, but a remote-control station for reactor replacement might be a future possibility.

Editor's Note: *Because the foregoing summary reflects the generally optimistic tone of the "Feasibility Study" released by Dr Borst, we must caution readers against any conclusion that only a few details need be worked out to make the atomic locomotive a practical accomplishment. The following points should be particularly noted:*

1. The tentative design was worked out by graduate students in physics as a study project in nuclear technology. These young physicists disavowed any engineering knowledge although they did get advice from experienced engineers and railroad men.

2. In general, both practical railroad men and nuclear engineering experts tend to view various details of the proposal with great skepticism.

3. It would appear that the problems of safety and public relations are more serious than the study suggests.

Power's DATA SHEET

No. 262

These Water Velocities Reduce Maintenance and Prevent Deterioration

Conditions to be prevented	Type of flow	Pipe or ditch material	Velocity limits feet per sec
Deposits of silt and mud	Vertical upward	All types of pipes and ditches	24 minimum
	45 degrees upward		13 minimum
	9 degrees upward		5 minimum
	3 degrees upward		4 minimum
	Horizontal		3.3 minimum
	3 degrees downward		2.6 minimum
	9 degrees downward		Almost zero
Rust formation	All types	All corrosive pipe materials	2.6 minimum
Deterioration of pipe walls	All types	Concrete pipe, carrying pure water	20 maximum
		Concrete pipe, carrying sand-laden water	10 maximum
		Steel and cast-iron pipe	50 maximum
		Woodstave pipe	40 maximum
Deterioration of ditch walls	All types	Fine-grained sand	0.6 maximum
		Coarse sand	1.2 maximum
		Small stones	2.4 maximum
		Coarse stones	4.0 maximum
		Rock	25 maximum
		Concrete carrying sandy water	10 maximum
		Concrete ditch, carrying pure water	20 maximum
		Sandy loam, 40% clay	1.8 maximum
		Loamy soil, 65% clay	3.0 maximum
		Clay loam, 85% clay	4.8 maximum
		Soil, 95% clay	6.2 maximum
		Clay	7.3 maximum
Formation of ice in ditch or race	All types	All types of ditches or races	5.0 minimum

Check Water Velocity To Reduce Maintenance

► THE INFORMATION in these tables is recommended as a guide in setting up and maintaining hydraulic systems. To use it, you must first decide which of these conditions is critical in your plant.

Water-velocity limits are based on the successful experience of two topnotch hydraulic organizations.

BY HANS W HAMM, *York, Pa.*

These Velocities Realize Special Conditions

Conditions to be realized	Velocity limits, ft per sec
Formation of ice cover in ditch or race	3 maximum
Desilting	1 maximum

Minimum Velocity to Prevent Pipeline Freezing

$$v = \frac{A(0.5T_w - T_a + 16)}{18{,}00\,D^2(T_w - 32)}$$

v = minimum velocity ft per sec
T_w = water temperature, F
T_a = air temperature, F
A = exposed pipe-surf. area, sq ft
D = pipe inside diameter, ft

© POWER

Cooperation in Engineering Pays Off in Performance at

ALBRIGHT STATION

Monongahela Power Co. — The Potomac Edison Co.

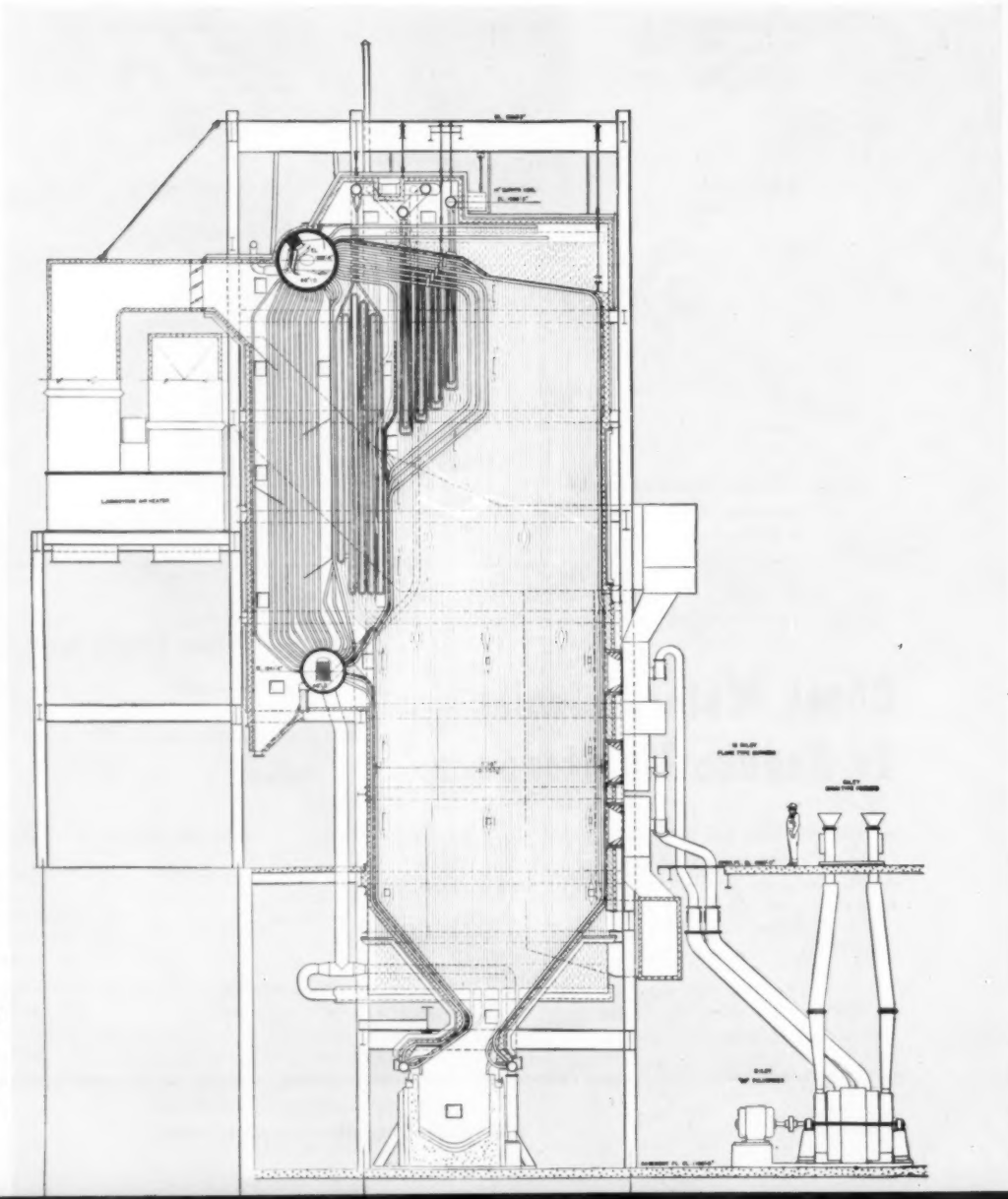
Special design considerations necessary to burn the low cost high ash portion of West Virginia deep and strip mine coal.

Analysis of Average Fuel

Moisture—4.7
Volatile Matter—25.2
Fixed Carbon—49.6
Ash—20.5
B.T.U. per lb.—11,570
Sulphur—2.54

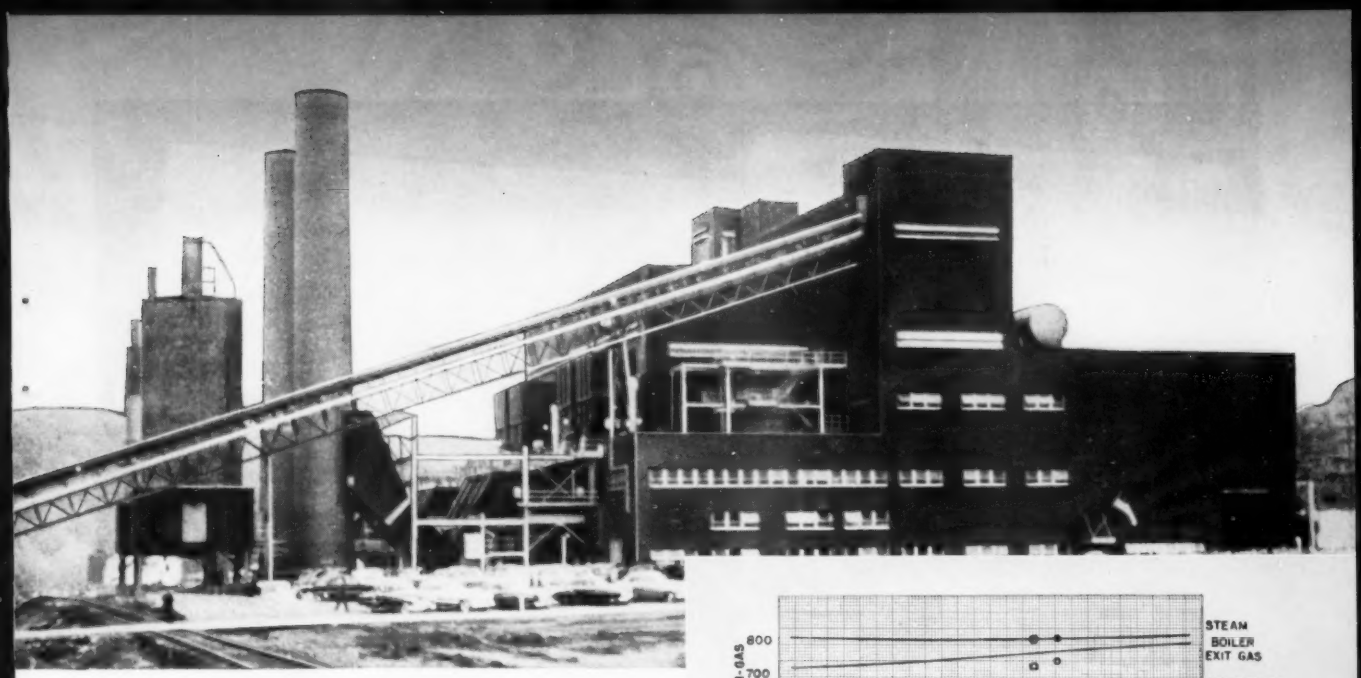
Engineering Data

Two Riley 700,000 lbs./hr. units
Design Pressure—1050
Steam Temperature 905°F.
Heat Release per Cu. Ft. of Furnace Volume—19,600 B.T.U.
Heat Release per Sq. Ft. of Furnace Envelope—104,000 B.T.U.
Furnace Length—22'6"
Furnace Width—36'3⅜"
Furnace Height—72'
Guaranteed Efficiency—86.8%
Actual Efficiency—88%



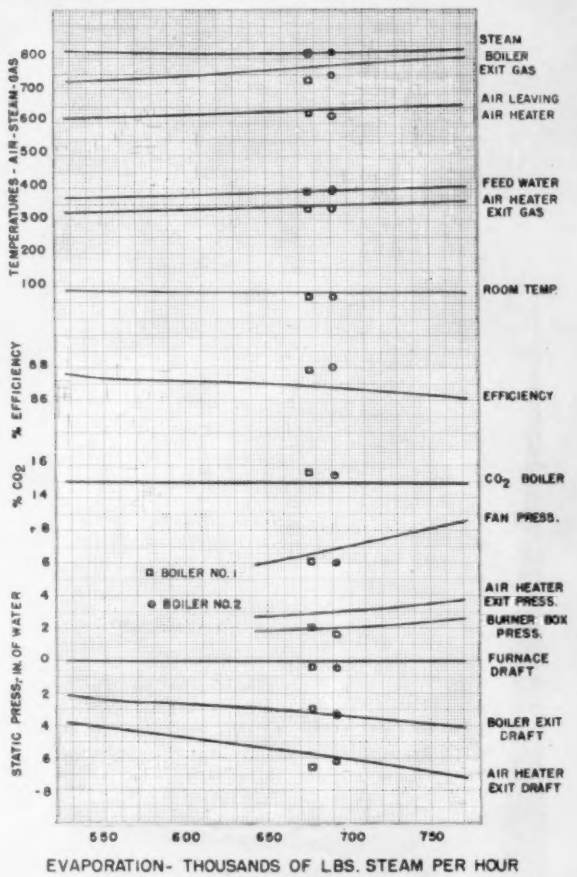
SANDERSON & PORTER
ENGINEERS

RILEY STOKER CORP.
WORCESTER, MASS.



Sitting literally on top of their West Virginia strip and deep mine coal supply, two Riley Steam Generators operate continuously at peak load day in and day out. Since the first of these two 700,000 lbs. per hour Riley units went on the line October 27, 1952, over 800,000 tons of this coal have been pulverized and burned. The heavy operating demand, plus the very nature of the coal—18.7% to 20.5% ash with softening temperature from 2100°F. to 2280°F.—meant that special considerations in design were necessary in order to avoid serious slagging. Close cooperation between the engineers of the Monongahela Power Co. and The Potomac Edison Co., Sanderson and Porter and Riley resulted in a design that features a heat release in the furnace of 19,600 B.T.U. per cu. ft. per hour with heating surface disposed to keep gases entering the screen tubes down to 2000°F. This design has produced higher than guaranteed efficiencies, which, with sustained high loads, makes possible low cost kilowatt production with turbines operating at maximum capacity.

Three Riley 550 series pulverizers fire each unit through twelve Riley flare type burners. Each pulverizer has a capacity of 40,000 pounds of coal per hour. Station engineers report, with water actually dripping out of pulverizer feeders, the flash drying characteristic of the feeder crusher-dryer sections of Riley's pulverizers dries coal so efficiently that pulverizer capacity is unaffected. Pulverizers are vibrationless and noiseless, and are equipped with Riley tungsten carbide grinding surfaces.



TRADE MARK Rx REGISTERED

RILEY STOKER CORPORATION

WORCESTER, MASS.

Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS
WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

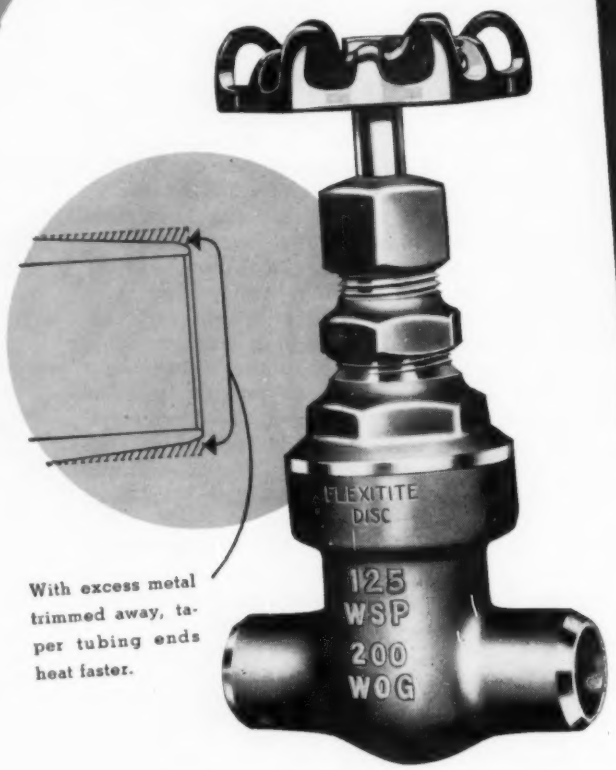
MAINTENANCE MEN PREFER
O-B VALVES FOR . . .

Fast heating
Easy soldering

● O-B bronze valves for copper-to-copper installation have been made especially heavy where weight counts ... in the body and centerpiece. But on tubing ends, where extra strength is not needed, excess metal has been trimmed away. When a torch flame is applied to the ends, they heat quickly and evenly to the right soldering temperature. Solder flows readily around the tubing, making a neat, leaktight joint.

Ohio Brass offers copper-to-copper valves at 125 pounds working steam pressure and lower in both globes and gates. Gates feature the self-adjusting Flexitite Disc®; globes have the free swiveling disc holder that eliminates grinding of the disc against seat. Your Ohio Brass distributor stocks these copper-to-copper valves together with other high quality O-B bronze valves.

Ohio Brass Company
Mansfield, Ohio



With excess metal trimmed away, taper tubing ends heat faster.

Ohio Brass Valves

BRONZE GLOBES, ANGLES, GATES AND CHECKS FOR
INDUSTRIAL AND DOMESTIC SERVICE

4445-V

TODAY, You Can Save Wrecked Machinery

By HENRY J VANDER EB
Engineering Consultant

► SUPPOSE one of your vital prime movers let go, or showed signs of failing tomorrow, what would you do? It might be a crack in a casting or shaft, or it might be a completely ruptured casting or cylinder.

You might have the best team of maintenance mechanics for miles around, and your shop might be equipped for emergency repairs—up to a given point. But chances are this is one time when you'd have to look for outside help.

In this situation, there are two courses open. One is to order new parts from the manufacturer, the other is to have repair work done by some method your insurance firm approves.

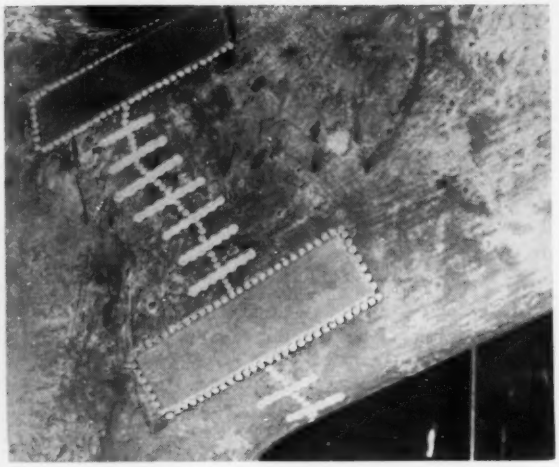
Usually it takes too long to wait for a large new part like a cylinder to arrive. If the machine is very old, say a corliss engine, castings and even the pattern might first have to be made. If your plant has no spare parts for this damaged equipment, outage while waiting for new parts may be costly.

One of two well-known emergency repair methods* approved by insurance firms is a patented process known as Metalock. One firm making these repairs is the Metalock Repair Service of Long Island City, N. Y. This company has successfully repaired not only the equipment shown on these pages, but also large crankshafts that were broken completely in two. Knowing that repairs can be made both on a static piece, like a casing, and on a dynamic part, like a crankshaft that twists and strains many times during every revolution, may pull you out of a deep hole some day.

How Is It Done? This is a method of making cold repairs on cracked, broken or weakened machine parts or pressure vessels of cast or forged metals.

Metal locks are locks—keys made of special alloys. Size and number used vary with conditions and amount of strength to be restored to fractured

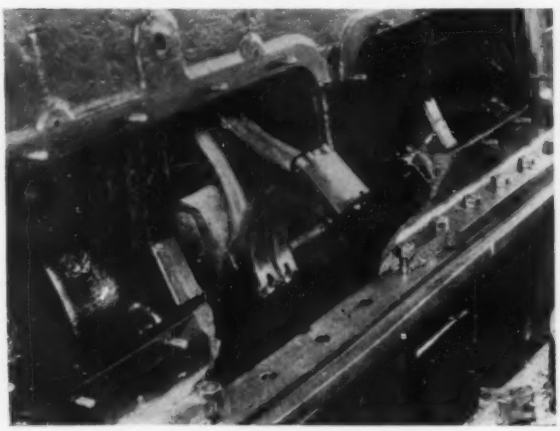
*Another emergency repair approved by insurance firms is that of the Harnan Process Co, El Paso, Texas.

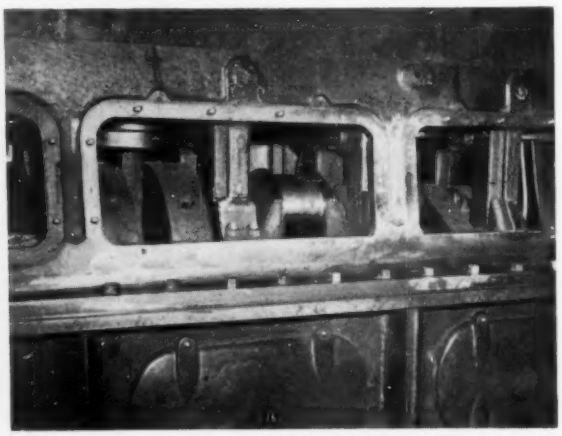


Spoke of 18-ft-diameter 38-ton flywheel was repaired 13 years ago. Still going strong

BEFORE One of the two giant spokes of this steam-driven ammonia compressor is badly cracked near the hub

AFTER Master locks, metal locks and metal lace repaired the cracks so the flywheel is still as good as new





Diesel engine housing wrecked by loose connecting rod is repaired right in place

BEFORE Lower part of engine housing has broken away, and connecting rod is poking through the open side

AFTER New section was cast, then hand-fitted and bolted in place before locking and lacing together

metal. Slots are cut transverse to fracture, *photo, top, right*. The locks are inlaid by cold working into parent metal. Thus, locks hold cracked or broken pieces to *fractured sections*.

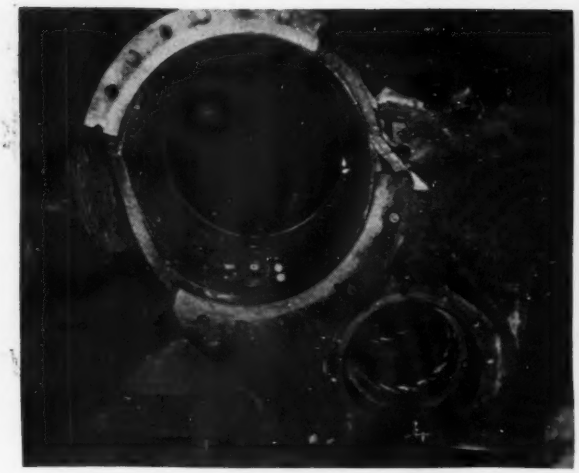
Master lock is an inlay of high-strength alloy plate, inlaid at points of high-stress concentration in broken castings or in broken sections subject to overloading. They are held in place by dowels, cold-worked into matching half-holes between the parent metal and the lock. Size and shape of master locks vary with requirements of each repair.

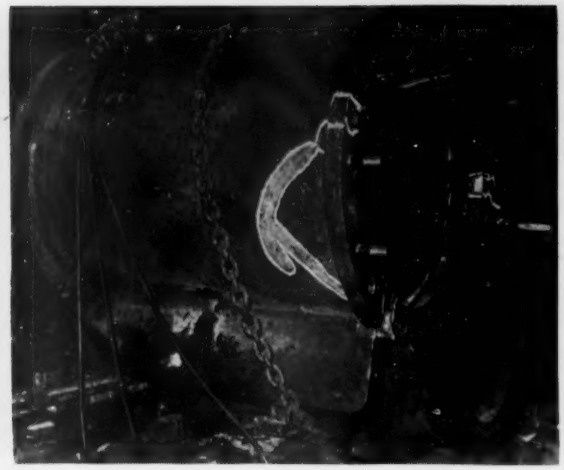
Interlock is a variation of the master lock. Holes of various designs are cut into the plate. When the parent metal is cut out to fit the form of the interlock, "islands" of parent metal, which fill the holes in the interlock, provide additional strength in shear. Usually this type of lock is used in weak castings, or in steel where some advantage may be gained by utilizing the support of parent metal more efficiently.

Metal lace is a method of sealing cracks against leakage. First, holes are drilled and tapped and special studs or dowels inserted tangent to each other along the line of fracture. Studs are cold-worked to insure complete filling and tightness of crack with new metal. Metal lace is used with metal locks to insure pressure-tightness and rigidity.

Special metals of high-strength alloys are used in repairs. The alloys include metals having a selective range of thermal expansion coefficients. Most corrosive and galvanic conditions can be met by these alloys.

Guarantee is given against leakage, extension of cracks, breaks in locks and parent metal within repaired area. Length of guarantee period varies with type of equipment and its service. Many jobs are guaranteed unconditionally for equipment's life. Work is done by service men the firm trains and licenses.





Cylinder of large rolling mill engine was wrecked, but is back on the job in 6 days

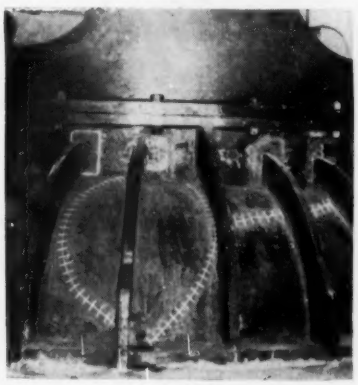
BEFORE Replacing this broken cylinder would have taken four months, with a daily outage cost of $8000

AFTER Repaired with metal locks, metal lace and master-locks, cylinder is ready to run the rolling mill again

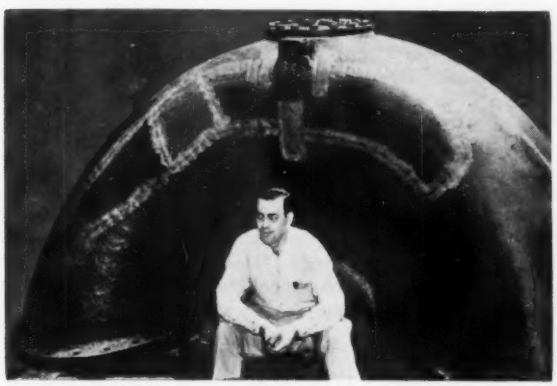
HERE ARE SOME OTHER TYPICAL REPAIRS

CRANKSHAFT of diesel engine is put back into service after repairing the crack

STEAM engine frame broken away from the cylinder is restored to full strength

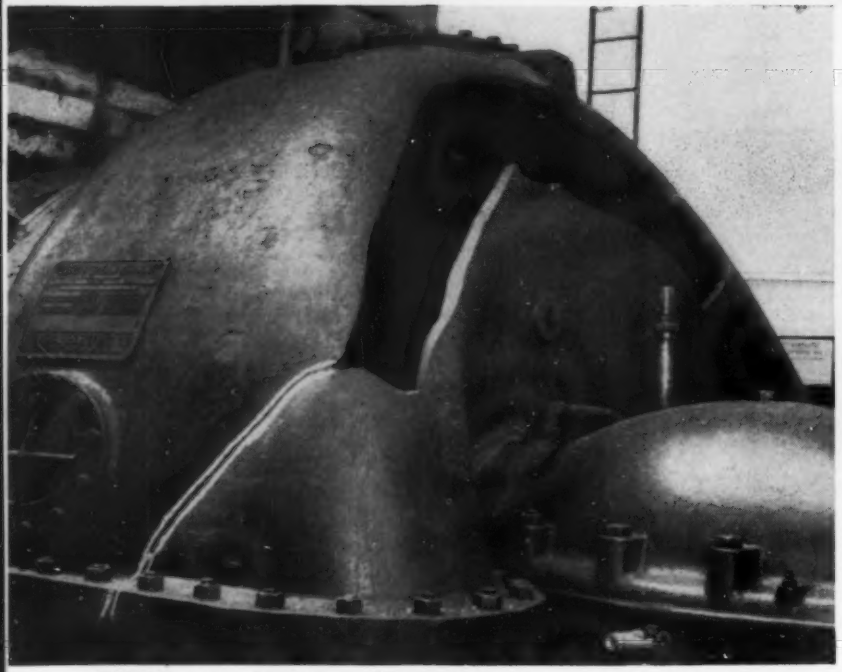


WATER turbines scroll-casing; repaired, reinforced by twelve still ribs as shown



TURBINE casing repaired, master locks used at areas of greatest strain. Hydrogen gas from acid cleaning did the damage here

TESTING strength and tightness of repaired body of 200 psi valve. At 2250 psi, the casting cracked, but not the repair



CONDENSER beneath turbine was also knocked out—making damage very costly

TURBINE exhaust hood let go when temporary piping, used to acid-clean the steam side of condenser, was dismantled with cutting torch. Hydrogen gas was responsible

Hydrogen Bomb In Your Plant?

By **BILL DAVIS**, *American Foundryman's Assn*

Things to Watch

- Acid cleaning is efficient but only if you have a reliable chemist in charge
- Never heat the acid solution above 140 F
- Keep all flame away from area where acid is used
- Vent unit to a safe point outside the plant
- Use explosive gas-detector

► THE ACID METHOD, for removing scale from boilers, condensers, heat exchangers, watercooling jackets, etc, is now common because practice and experiments show that it can be controlled. It won't attack metal that is being cleaned.

This method gives a better, quicker job. By the old method, you take days to open the boiler, turbine the tubes, or rattle them clean. Even then, many parts can't be reached manually for complete scale removal. This holds true for condensers and machinery having watercooling jackets. Besides, manual scale removal takes time, while inhibited acid reduces the same equipment's down time.

Danger is that hydrochloric acid attacks iron or steel and gives off hydrogen gas. This gas can combine with air over a wide range to cause an explosive mixture from 4 to 75% by volume. That's why you must do it right.

Hydrogen coming in contact with an iron-sulfide scale gives off hydrogen-sulfide gas, called rotten-egg gas because of its odor. A strong concentration of this toxic gas might overcome anyone before he knew he was breathing a deadly gas. In fact, small amounts might paralyze his sense of smell so that he wouldn't notice the bad odor when concentration became heavy.

Explosion of a 550-hp Stirling-type watertube boiler caused the deaths of a boiler inspector and an engineer, besides injuring four operators.

Hydrogen-bomb effect was caused by using chloric acid as a cleaning agent with an inhibitor. After acid mixture was added to boiler water, it was raised to a high level in upper drums. Fire was built in boiler to raise temperature of water-acid mixture for quicker action. This mixture was heated until steam pressure reached 25 psi. After fire was allowed to die down a short period, pressure was raised to 40 psi.

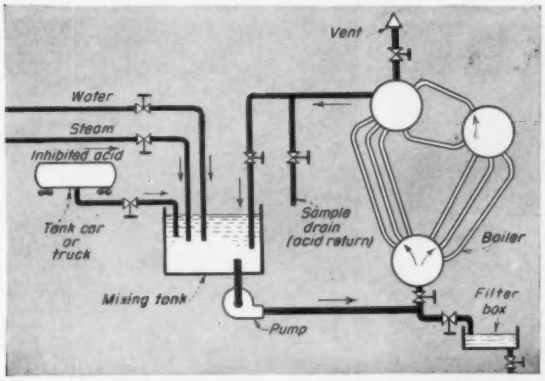
Because main stop valves had been closed, boiling acid water-mixture reached at least 225 F. Inhibitor failed to function as it broke down at about 140 F and allowed hydrochloric acid to have an uninhibited chemical action on boiler metal. That released hydrogen.

After boiler cooled down it was drained. Explosion took place while it was being opened up. Sparks probably came in contact with a large volume of hydrogen gas in boiler drums.

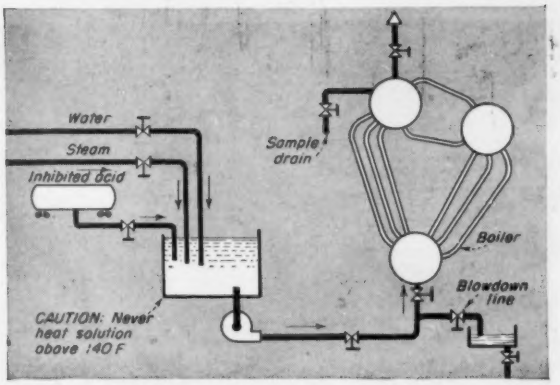
The personnel never should have acid-cleaned that boiler. Why? It was a perfect setup for an accident.

Turbine Explosion. A turbine and its attached condenser blew apart while being cleaned with acid. Fortunately there were no injuries. But there was plenty of damage to condenser and turbine, *photos*. Hydrogen gas given off during cleaning had leaked back through condenser water-boxes to turbine. Explosion was from open flame of a cutting torch.

Temporary piping had been used to introduce acid-water mixture into the condenser. Piping was being removed with a welding torch when it exploded.



CIRCULATING METHOD pumps acid from mixing tank into the vessel being cleaned. Keep circulating until scale is gone



SOAKING METHOD hookup pumps acid solution into vessel where it remains until scale is dissolved. Filter removes sediment

Now that I have thoroughly scared you, I can't just leave you. Cleaning internal and hard-to-get-at surfaces with acid has too many advantages. Fact is, it's becoming a common method, but the job must be done safely.

Don't do the work unless you are familiar with and trained in every phase of the operation. Thoroughly experienced chemical firms do the work at a nominal cost. You won't save much by doing it yourself.

Safety. Before starting an acid-cleaning job, make complete plans for each step: how to connect acid lines, how to dispose of residue from cleaning process, locations of vent and discharge points, how to handle acids.

Chief engineer should consult chemist and take tests of feedwater just before draining the boiler. Remove scale samples for chemist to analyze so he knows strength of acid solution to use.

If there are sulfides in scale, hydrogen sulfide gas may be given off. Then plan for this hazard by venting gas through a caustic water solution. Also, equip anyone entering boiler with air-supplied gas masks.

Connect and place hoses so, if personnel come in contact with acid, they can flush it from their persons quickly with large volumes of water.

Equip all employes with splashproof face and eye shields, also gloves, aprons and shoes or boots of rubber. Enclose all portable electric extension lights and use explosionproof globes only. Use low-voltage lights in boiler interior. Flashlights may spark enough to ignite gas.

Two cleaning methods are (1) forced circulation and (2) soaking. In forced circulation, the inhibited acid solution is heated and pumped through unit back to receiving tank, *see sketch*. In soaking method, inhibited acid solution is fed into unit and allowed to stand until tests show no scale, *see sketch*.

Acid solution may be hot or cold. Heat speeds up cleaning action. CAUTION! Never heat solution above 140 F. Above this, there's danger of breaking down inhibitor, then acid attacks the metal.

If solution is to be hot, heat in a preheater or unfired pressure vessel with steam. Never heat solution by direct firing. Rope off area about unit to be cleaned; allow only authorized persons in the area. Post "No Smoking" signs. Joints of threaded pipe are best for conducting acid because a welding torch is always a hazard.

Instead of closing valves, open and blank off all steam and water connections to boiler with blind flanges. Vent unit to a safe point, to outdoors through roof or other high point, with no pockets in vent line. Keep this line short as possible. Where a test shows sulfide scale, you can expect hydrogen-sulfide gas. In that case, lead the vent line through a tank of strong caustic solution. Alkali then neutralizes this acid gas.

When cleaning a vessel that hasn't been isolated from interconnecting equipment, vent the connected equipment at its highest point. For instance, when acid-cleaning a condenser that has not been disconnected from its connected turbine, open the turbine casing and force-ventilate constantly for some time after condenser has been cleaned.

Use an explosive gas-detector meter and make checks at vents and about boiler or vessel during cleaning process. If test is positive, start blower fans to dissipate gas before it reaches an explosive limit. This is important after vessel has been drained and is being flushed out. More gas may escape at this time to form explosive pockets.

Pollution. Because local officials are getting conscious of overloaded sewers and stream pollution, neutralize the acid when it is drained from vessel being cleaned.

Simple acid-disposal method is to fill a large water-tight box, cistern, or open tank with limestone to form a filter bed. Drain acid to filter-bed top to neutralize by flushing with water through limestone. Then drain from bottom of filter bed to sewer or stream. Test acid at this drain point to see that solution is neutralized.

After cleaning and draining, flush thoroughly with water. It is possible to circulate plain water through smaller unit until all acid indications are removed from flushing water.

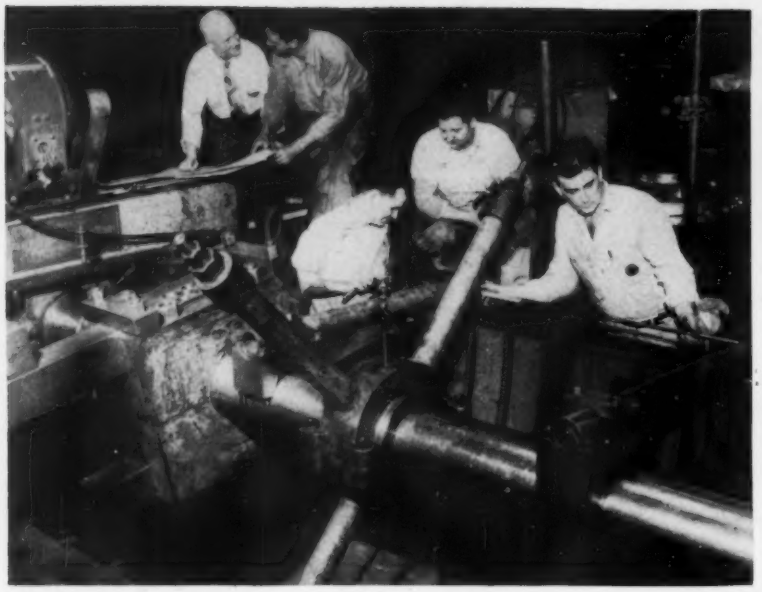
For larger units, fill and drain once or twice, then fill with a hot alkaline solution of 1 or 2%. Follow with another flush of clean water. This neutralizes any acid remaining and will release hydrogen gas, if trapped in pockets or absorbed by metal.

Your units will then be ready to open for inspection or maintenance repairs. Before anyone enters a boiler or pressure vessel, ventilate it thoroughly with blowers or fans. Ventilation shoves out toxic gases and provides fresh air so there's no danger of being overcome from an oxygen deficiency.

Did you know...

that the basic colors of the Safety Color Code, as approved by American Standards Assn, are given in their booklet, *Safety Color Code for Marking*? It's available at 70 E 45 St, New York 17, N. Y. They are:

RED: danger — ORANGE: on guard
YELLOW: hazard — GREEN: safety
BLUE: electricity — PURPLE: radiation
BLACK and WHITE: dead end



ALIGN boring bar to remove eroded metal from diaphragm sealing faces of this turbine casing. Cover is then bolted on, bar-controlled from outside by telephone

DIAPHRAGM sealing surface around rim is eroded from many years of wet steam

STAINLESS-STEEL strip is pinned around machined rim, then turned down to fit

New Life for Old Turbines

By G INGRAM and E SEBRING, *Philadelphia Electric Co*

ANGLE IRON of stainless steel: forced into the machined casing after boring

► OUR STEAM TURBINES were a growing problem because the sealing faces of both casings and diaphragms eroded as a result of being cut by moist steam. Because of steam leakage from this erosion, the machines' efficiency gradually dropped. We had to do something to save these turbines.

Casing Repairs. We machined 1/16 in. from the eroded steel section of the cylinder, then built it up by welding. Electrode was 25-20 stainless steel. But the cast-iron section was another matter as we found that welding was impractical for this job. After experimenting, we worked out a method of forming and fastening stainless-steel angles in the cast-iron casings. Method was so successful that one of our 35-year-old units is now carrying its share of load again.

First, we aligned a portable boring bar in the turbine casing, photo. Boring-bar shaft is 10 in. in diameter and 22 ft long. We had to remove about 3/16 in. of cast iron to prepare surface for installing stainless-steel angle iron of ¼x2x2-in. dimension.

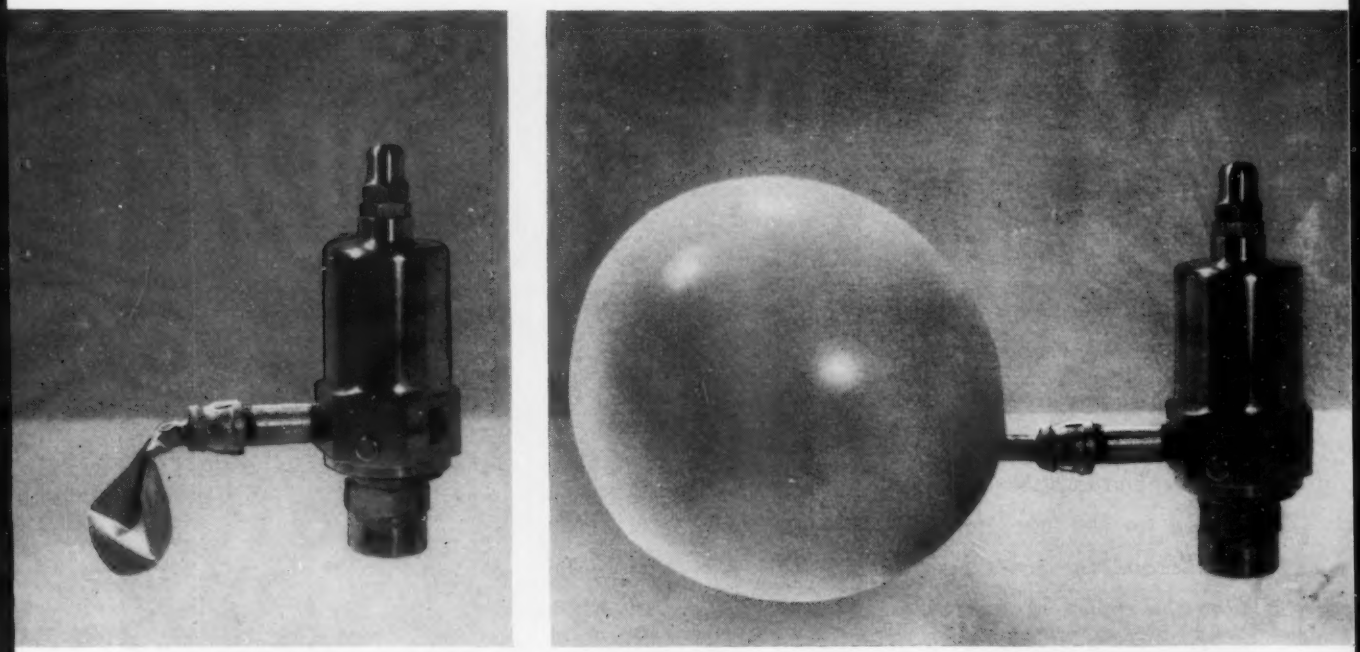
Then boring bar was removed and angles were pressed into the casing with hydraulic jacks. Next, we drilled through the angles into the casing, tapped, counterbored and inserted stainless-steel screws. They were then welded to angle irons by plug welding. We machined the seal faces to original dimensions with the boring bar.

Diaphragm Repairs. Some of the diaphragms are steel, others cast iron. We machined 1/32 in. off the seal face of these diaphragms. Face was then built up by welding with 25-20 stainless-steel electrode. Last operation was to machine them to the original dimensions.

Cast-iron diaphragms were machined on outer edge to allow for a ⅝x1½-in. stainless steel-band, to be inserted and pinned on with countersunk screws, then locked. Bands were machined to original specifications, photo.

Several turbines have been repaired in this way to date. And they are all operating to our expectations.

EDITOR'S NOTE: *Cast-iron turbine casings have also been built up by welding. But trick is to first remove the eroded or defective surface metal entirely. Then surface graphite, which is cause of failure, is removed, and you deposit your weld on sound metal. After preparing metal thus, build up with a suitable nickel or other electrode that is commonly used for welding cast iron.*



DIME-STORE BALLOON, hooked up to safety valve and fan to speed up condensation, gives simple means of getting leakage rate

Get a Tight Safety Valve!

That was the assignment. How would you have tackled it? Here's what one of our men did with some odds and ends, plus ingenuity

By **H J BELLARTS,** *Mechanical Engineer*
General Electric's Hanford Atomic Products Operation

► OUR FAITH in American ingenuity was bolstered recently when one of our men carried out an assignment in a rather novel way. Maybe you can't use the results directly in your plant, but the way he solved a difficult problem will interest you.

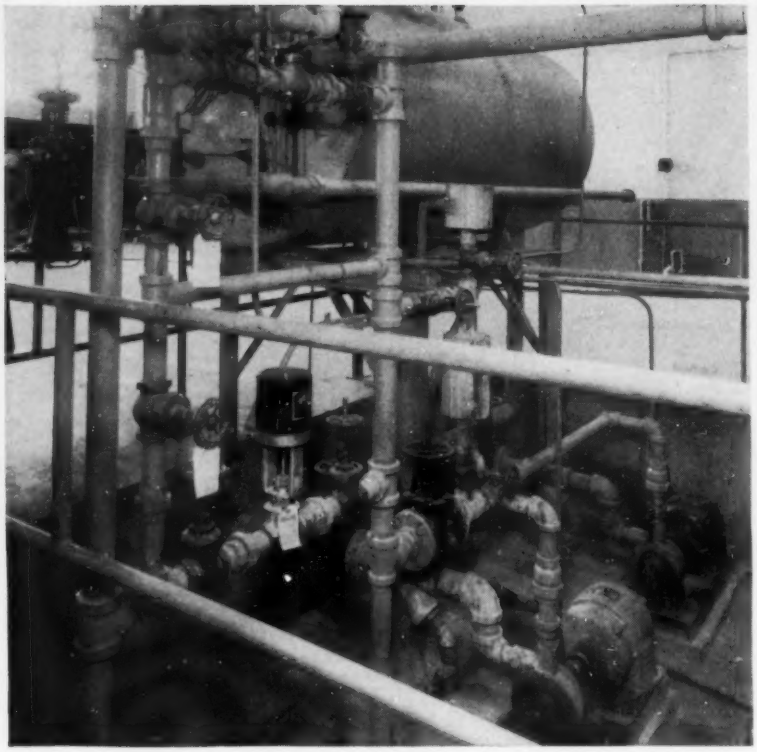
We were running an important test program, and a leaky safety valve stymied the whole works. A valve with a maximum leakage of 0.06-lb-per-min steam at 2100 psig was needed, but fast.

Help was asked from the Puget Sound Naval Shipyard at Bremerton, and we sent one of our engineers there. He was to come back, but only if he brought a workable valve.

To start with, Bremerton didn't have steam available at the pressure required. So the yard workmen wrapped a rejected 16-in. recoil cylinder with resistance wire and covered it with asbestos. A gage and a safety valve connection were added to complete the "boiler." Water was put in the steam generator, heated for several safety-valve pops, cooled, and more water put in.

They tried several valves with this rig, many of them leaking like sieves when the "boiler" pressure really went up. However, they finally came up with a variation of a standard valve that gave some promise. But this wasn't enough. The yard had no means of measuring the leakage, and this measurement was necessary before the valve could be accepted. No time was available to rig an elaborate condensing and weighing system, so our man went shopping.

Dime-Store Balloons. He purchased a quantity of the best balloons the dime store had. These balloons were attached to the safety valve discharge to catch the steam leakage during the test. To speed condensation in the balloon, a fan was directed on the balloon surface. With this setup, our man made ready, accurate measurements of leakage rate. He came back with a workable valve and a couple of spares to boot.



TWO FEED PUMPS, each rated at 45 gpm, serve a 23,000 lb-per-hr boiler. One pump handles light and medium loads. Second cuts in automatically during heavy loads

Sizable savings are possible in many boiler-plant feed systems when the right hookup is chosen for the job. Here are details on the reasoning behind the choice of number of pumps, their capacities, controls and piping layout

By **R F SCHAUB,** *Vice President, Fred H Schaub Engineering Co*

For Better Economy in Small Plants

► YOU'LL FIND plenty of small plants today using a single motor-driven constant-capacity boiler-feed pump with on-off boiler-water-level control. And often you couldn't find a better way to do the job.

Advantages. Such a hookup has low first cost, small running cost, simple automatic controls and little maintenance. But it has one limitation that may not be an advantage in certain plants. This is its inability to provide a continuous feed characteristic that closely matches the evaporation rate.

Job Conditions. How important is continuous feeding? It may be of great importance. Then, again, it may mean nothing. Relative importance depends on a number of job conditions. Matched or continuous feed can save money.

Feedwater temperature, amount of boiler overload expected, and type of combustion controls are considerations. But usually it is the type, size and operating pressure of the boiler that determines the importance of continuous feeding.

Example. Let's assume we have a 275-psig watertube boiler rated at 40,000 lb per hr. Feedwater temperature is 210 F, steam temperature 414 F. With a difference of 204 F between steam and feedwater, continuous feed at a rate equal to the evaporation is a must for this job. With but one pump running start-stop, there would be frequent and undesirable load changes because the temperature difference is so large, and the pumping-rate differential is substantial.

The usual watertube boiler of this capacity does not have enough reserve storage to take the swings induced by intermittent feeding. For this job a 2- or 3-element feed regulator would probably be chosen.

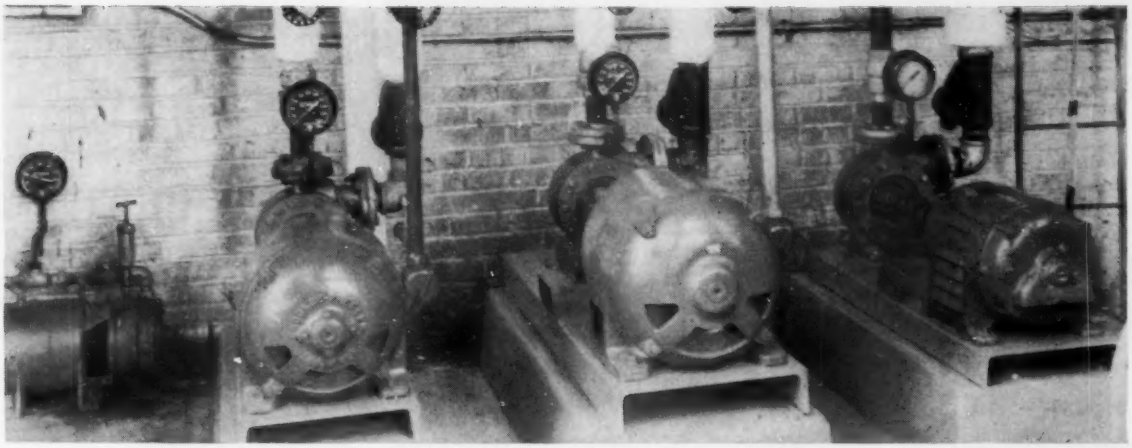
Firetube Boiler. Now let's suppose we have a 3000-lb-per-hr Scotch or hrt boiler receiving feedwater at 210 F but operating at only 90 psig (331 F). Difference between boiler water and feedwater is now only 121 F. The boiler has relatively large water storage and steam spaces. There's enough reserve storage to take care of swings caused by intermittent feeding. On a job like this a single simple on-off pump leaves little to be desired.

Other Jobs. But what about boilers rated at 5000 to 25,000 lb per hr in the 100- to 250-psig range? Here continuous or matched feed is neither critical nor negligible.

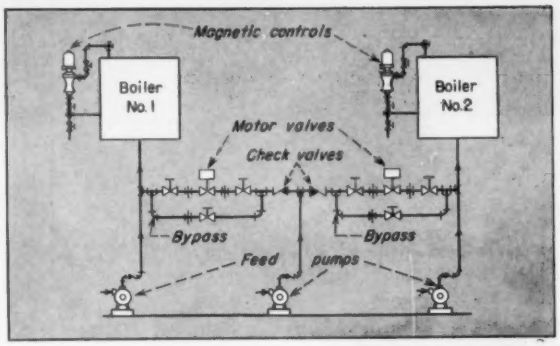
Let's assume we have a 145-psig (363-F) boiler, firetube or watertube, rated at 10,000 lb per hr. Average evaporation rate is about 20 gpm.

Normal choice for a single intermittent feed pump would be a 10-hp unit rated at 40 gpm at 150-psi total dynamic head. This gives the usual 2 to 1 safety factor.

First cost of this hookup is low, pumping cost favorable. But half the time the feed rate is 20 gpm greater than the evaporation rate. And half the time, when the pump is off, it's 20 gpm under the evaporation rate.



INSTALLATION of three feed pumps for 30,000 lb-per-hr boiler load. Two of the pumps serve all normal loads. The third is for standby service. Each pump has mechanical shaft seals, and is equipped with permanently lubricated ball bearings



PIPING HOOKUP for three pumps feeding two boilers. The motor valves and magnetic controllers give completely automatic operation of all three pumps. Carefully planned hookups like this can save many operating dollars and give better output

Try Matched-Capacity Feed Pumps

Half-Size Pumps. But suppose we used two half-size pumps, each rated at 20 gpm at 150 psi, and each driven by a 5-hp motor? Pump controller would be a 2-stage unit. We'd have the same total pump capacity and motor horsepower but with significant operating differences.

First, our feed rate now closely matches the evaporation rate. Occasionally, on lighter-than-average loads, both pumps will stop running. When load exceeds the average value, both pumps run briefly at the same time. But for practical purposes, we've obtained a continuous matched-feed characteristic for this installation.

Electrical hookup for the two pumps is simple. All we need is a 4-pole double-throw switch to change from one pump to another so wear is equal in each unit. With a magnetic 3-level-stage boiler-water-level control, the third or bottom stage can be used for separate low-water cutoff, an alarm, or both.

Where load varies widely under day-night or winter-summer operation, flexibility is obtained by selecting a suitable capacity for each pump. For example, with a minimum load of 7000 lb per hr and a maximum of 14,000 lb per hr, we could choose an interchangeable combination of a 15- and a 30-gpm pump. These would match either load quite well, with excellent operating efficiency.

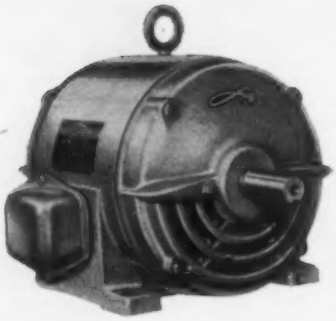
For more than one boiler the same result can be obtained by using one matched-capacity pump for each boiler and a common pull-in pump that automatically increases feeding rate of any boiler that requires more water. Diagram, *above, right*, shows how this is done by using motor-operated valves that open wide and have no more flow resistance than a conventional open globe valve. Though the diagram shows only two boilers, a similar hookup is suitable for three or more.

Other Gains. Three other important advantages are: (1) Second pump automatically gives required standby capacity because its rating is usually sufficient to maintain boiler water level in the event the other pump fails or must be taken out of service for overhaul.

(2) Pumping economy is improved because one half-size pump runs continuously (or almost so) while the other cuts in only rarely.

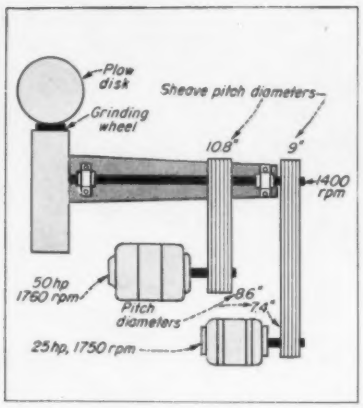
(3) If plant electrical system is overloaded, or nearly so, using smaller motors to drive half-size pumps, together with the manner in which they operate, is more favorable than starting and stopping one large motor for a full-size pump.

The 2-stage motor-driven feed-pump hookup retains the best features of single-pump on-off feeding while adding the benefits of continuous feed, and other related advantages. It is a hookup that is easily and inexpensively adapted to many one-pump plants today.



Boosting 50-hp motor...

with a 25-hp unit...



PARALLEL HOOKUP of the drive units, although economical, can be very tricky

...Saves dollars on dual drive

By LEE E SHARP, *Krause Plow Corp*

► MOST CHARACTERISTIC of industry today is the speed with which developments in equipment and materials force the engineer to introduce changes in his machine setups. Such changes can be quite expensive, but often a little ingenuity saves a lot of money.

A good example of the money-saving power of simple ingenuity cropped up recently in a grinding operation. The grinder in question was used for sharpening plow disk blades and was designed to be driven by a 50-hp motor. Some time after installation, a new type of stone was found to increase production at lower cost per stone. But using new stone necessitated increasing power supplied to grinder.

To meet space limitations and to avoid expense of buying a single larger motor, an available 25-hp motor was banked with the original drive, as shown in above diagram. The problem was not to add a second motor of equal size, but to belt a smaller motor so it would run at correct speed and carry rated horsepower while original 50-hp unit was running at its rated speed and horsepower.

In the original setup, an 8.6-in. pitch-diameter (pd) motor sheave, coupled with a 10.8-in. pd grinder sheave, reduced the 1760 rpm of 50-hp unit to 1400 rpm on grinder. The 25-hp motor now had to be sheaved so that at its rated speed of 1750 rpm, it would deliver power to grinder at 1400 rpm. Calculations based on these figures showed that a 7.4-in. pd motor sheave and a 9-in. pd grinder sheave would do the trick.

An additional problem resulted from load variations inherent in any grinding operation. During the time the blade was in contact wi h the stone, load increased from 50 to 100 hp. Although this peak load exceeded combined motor rating, minimum-load and idle-running time were enough to keep motor temperatures within safe limits.

During handling time, which was 32% of cycle, the 25-hp motor assumed load of running the 50-hp unit and unloaded grinder. The 50-hp unit assumed its portion of the load as soon as the blade contacted the stone and continued to do so throughout entire grinding time, or 68% of the cycle.

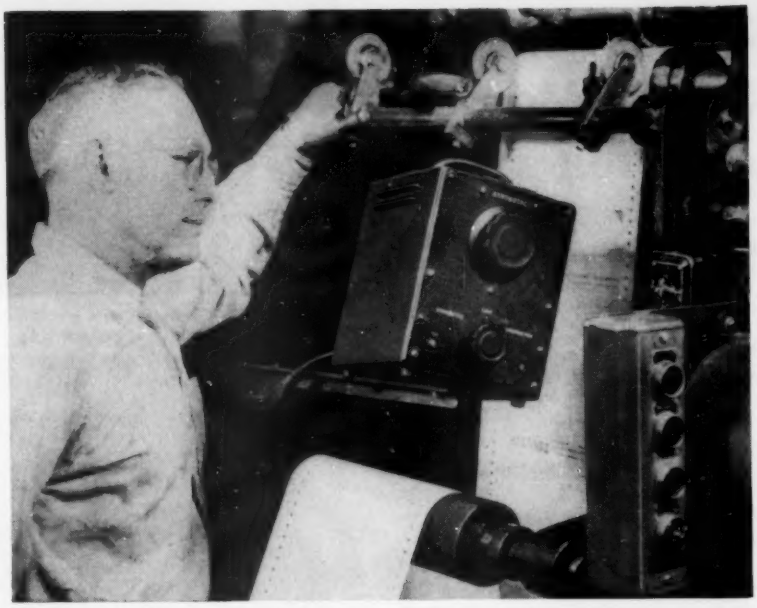
In designing the above dual drive, it was necessary to use motors with nearly equal full-load speeds: same percentage of slip at full load. If slip percentage varies at full load, motor with least slip will run above its synchronous speed during no load and will operate as an induction generator, thus adding to load of other unit. The importance of this condition becomes apparent when we consider that an induction motor acts as an induction generator when driven just 3% above its synchronous speed.

Important facts to remember in a dual-motor drive such as this are: (1) In working with induction motors, speed drops and current increases as load is applied. (2) Full-load speed rating is speed to which motor drops when full load is applied. (3) Induction units must not be considered as constant-speed drive when used in a multiple-motor drive. Consideration of these factors will show how to parallel available motors and avoid cost of buying new units.

Here's how to use

The Stroboscope

By P J BELCOURT
American Cyanamid Co



SMALL PORTABLE stroboscopic tachometer supervises high-speed, continuous form printing to maintain accuracy of the punch holes in relation to the printed lines

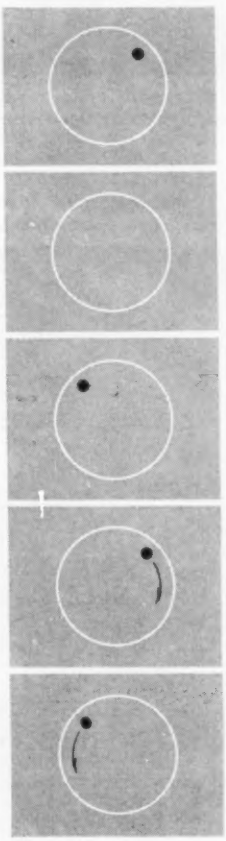
► A GENERATOR of short but accurately-timed light flashes, the electronic stroboscope permits rotating, vibrating, reciprocating and other periodically moving objects to be viewed as if they were stopped or were moving very slowly.

Various applications of this instrument can be found throughout industry, and, since the device extracts no power from equipment being tested, it is especially well adapted to the study of low-power machines. One interesting application was the close examination for pitting and grooving in collector rings on wound rotor and synchronous motors. Stroboscopic inspection permitted examination without stopping equipment. Another use was examination of commutator segments and mica-separators on dc commutators for looseness and burned or flat spots.

In a recent case, the stroboscope revealed one loose segment on the commutator of a 3500-hp dc motor. If this had not been found in time, costs of damage and down time would have been tremendous. In another case, a riser from commutator segment on a large dc-motor armature was arcing. The stroboscope detected the dark spot while unit was in operation and avoided another expensive breakdown.

Belt-slippage is another fault that the stroboscope, coupled with a clamp-on ammeter, can detect. As belt slips, shaft appears to turn slowly in reverse and ammeter reading drops slowly. When belt again grabs, shaft "stops" and current rises to normal. Other miscellaneous jobs for the stroboscope include reading serial numbers on high-speed equipment while it is in operation. Applications for this versatile device are numerous at present and are increasing daily. The stroboscope's value can be expected to increase steadily as more and more plant men turn to it to solve their high-speed motion problems.

and here's how it works



At rest

Disk with painted spot is mounted on 1800-rpm motor. Here motor is at rest in ordinary light and spot is clearly visible

Full speed

At 1800 rpm spot disappears. Motion is much too fast for eye to pick up separate image under ordinary lighting methods

Full stop

Stroboscope flashes light on disk at preset rate of 1800 times a min. Disk seems at rest, since each flash now hits same spot

Slow forward

With flash rate at 1799 times a min, disk moves at 1 rpm forward. This slow motion lets eye follow high-speed sequence

Slow reverse

With flash rate of 1801 times a min, disk moves backward. With proper setting, stroboscope reverses motion sequence

Series of images

Although it produces a series of separate light pulses, the stroboscope gives illusion of continuous slow motion or complete absence of motion. Principle here resembles continuous motion of ordinary moving pictures: The eye retains each image for about 1/20 sec so successive images overlap. At high speeds there is no image distortion. Flicker and blur set in when flash speed drops below 600 times per min, a relatively slow rate.

Photos this page are through courtesy of General Radio Co

3 Tools to Speed Motor Maintenance

By F W KRAUS, *Superintendent*
Methods & Tools Dept, Otis Elevator Co

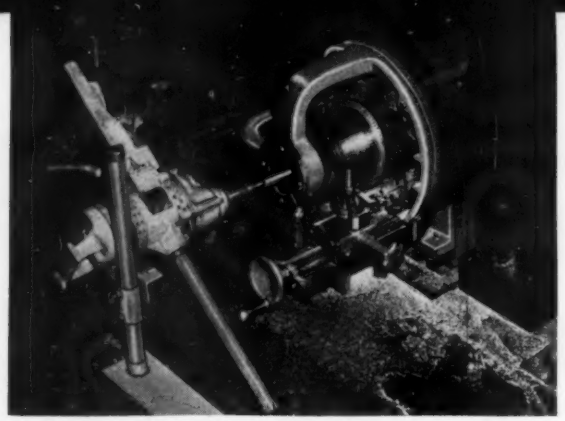
► DESIGNING TOOLS for specific jobs around the plant does pay dividends. Take the three we've listed here. Each was dreamed up to fill a need that store-bought items couldn't fully meet.

Turning rig, *Fig. 1,* in the form of a ¾-in. electric drill, does a top job for field-turning commutators. Drill-and-stand combination saves pulling the armature and lugging it back to the shop. Driving stem between armature shaft and drill chuck is a 1-in. hexagon rod having a ½-in. 13 thread on one end, the other end turned to ¾-in. diameter. We use hex stock so an open-end wrench will do when installing and removing driving stem on shaft end of armature.

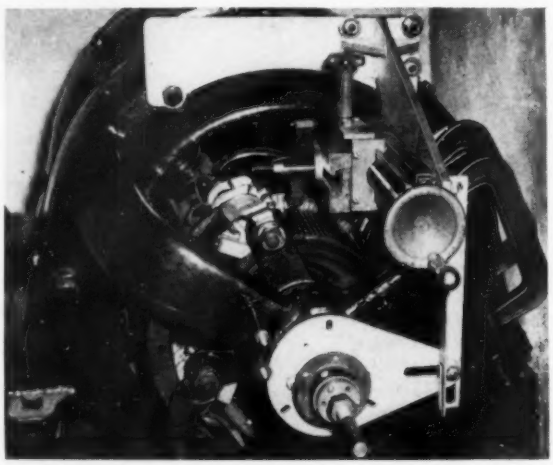
Note the motor's end bell. This is a standard unit that was altered by welding on a supporting base to take the commutator cutting rig. One of the four bell feet was cut away to make room for cutting-tool base. The altered end bell is kept in stock just for use in turning down this type and size motor or generator.

Cutting kit, *Fig. 2,* attaches directly to machine, side-stepping need for removing end bell when a commutator is to be turned. Of course, the decision you must make is whether it pays in your plant to turn commutators without removal to the shop. In our case doing the work pays off; otherwise, we would have to dismantle elevator motors and generators and carry them a good distance to repair shops. And, in the meantime, elevator is shut down or is operating with a replacement unit. So, for us, turning commutators on the job certainly pays.

Stator pulling rig, *Fig. 3,* is made from a bridge-type frame of channel steel that fits against the stator frame. A T-handle hoisting screw passes through center of bridge frame and is swivel-connected to a lifting channel. Latter has a hole at each end for the shoulder bolts, which line up with tapped holes in stator core. Sure, this is a "special" for a type motor we run into often. But the idea can also be adapted, possibly with adjustable dimensions, for a range of motors.

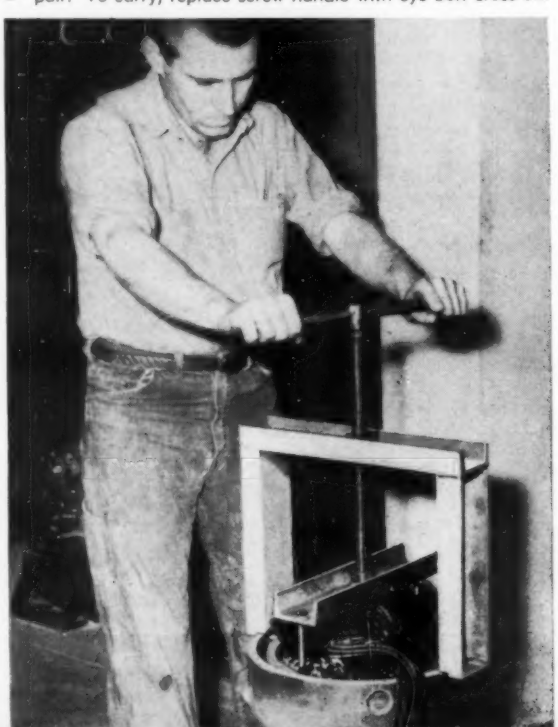


1 **TURNING RIG** uses ¾-in. electric drill on plantmade stand. Specially adapted end bell holds tool base when turning down

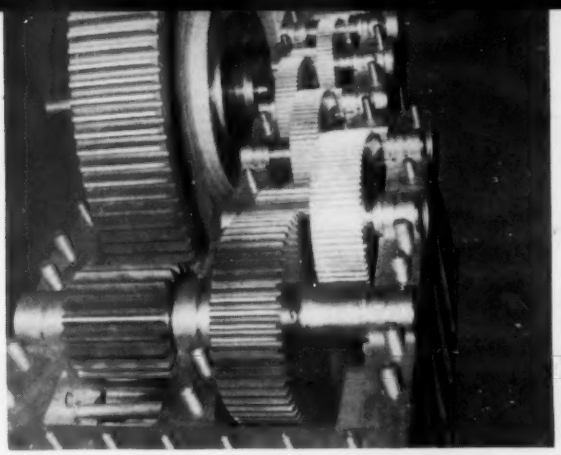


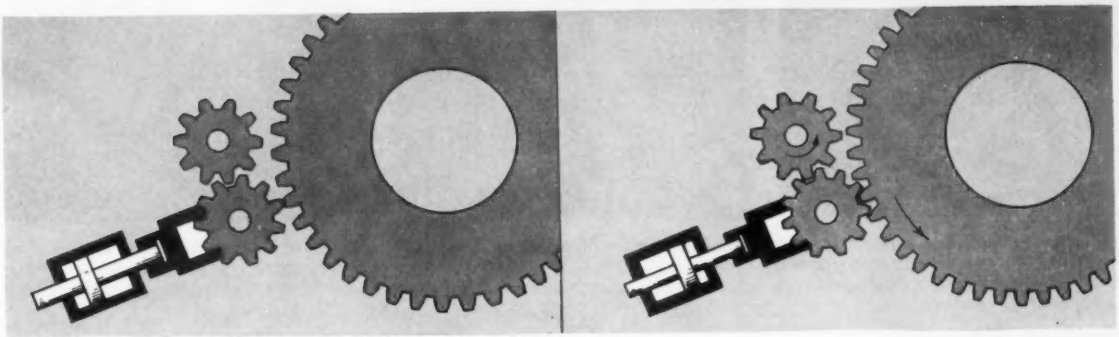
2 **CUTTING KIT,** *above,* avoids need to remove end bell. Rig clamps direct to feet of end bell, holds cutting tool firm

3 **PULLING TOOL** eases stator from frame for winding repair. To carry, replace screw handle with eye bolt cross bar



This Automatic Turning Gear...





...Slowly Feels Its Way ...Until Gears Mesh

Fully automatic rig for turning large rotors was slated for a wind-tunnel compressor. But details are of interest to all operating men

By S D PHILLIPS, *Mechanical Engr Dept*
Westinghouse Electric Corp

► IN THE PAST, gear shifting for rotor turning was done by sliding one gear axially a distance greater than tooth-face width, bringing mating teeth into mesh. True, occasionally the shift was made radially, as in this case. But radially or axially the risk of tooth breakage was great in the past because load was applied before mating pair reached their full-capacity position.

New Rig. Big feature of this new turning-gear design is the method of automatically engaging and disengaging. Gears are engaged radially rather than axially. This is most practical since the axial distance required to move one of a pair of mating gears from free to full mesh position is too much, especially with the size gears used for turning large rotors. Using radial shifting, the engaging gear need move only slightly more than tooth depth. This means faster shifting and ease of automatic control.

Drive motor for turning-gear starts at reduced voltage to cut size of starting torque. Jogging arrangement is set up for smallest angular displacement of gear train. Interlocks between main drive and turning-gear drive automatically prevent engaging turning gear once main motors are started.

Main Components. *Bull gear*, suspended on compressor shaft extension, is free to turn as a flywheel while compressor is running, but is held in engagement when compressor is slowly turned by turning gear. *Idler gear*, free to turn about its stationary shaft, engages the bull gear. The *gear train* shown is a 6-reduction folded arrangement running from the turning-gear drive motor to the idler gear.

All gears are spur type, modified for improved tooth action. Teeth in this case range from six to two diametral pitch. Drive motor bolts directly to gear case with shaft spline fitted into gear train pinion.

Drive motor is a 3-hp 3-ph 60-cycle 440-v 1160-rpm explosion-resistant induction unit equipped with auto-transformer reduced-voltage starter.

Hydraulic piston provides the push to engage idler gear with bull gear. This piston is mounted in the idler gear line of travel.

Operation. Turning gear will engage through an electromechanical control system when main drive is discontinued. The automatic operations start either when main shaft is stopped or when a control-station pushbutton is pressed. A pressure switch and 4-port 2-way solenoid valve divert oil to piston, which pushes the yoke-mounted idler gear toward bull gear.

By chance the tooth-to-space relationship may be such that gears engage at once. If so, a position switch is energized when idler reaches the deep mesh position, starting the turning-gear motor at reduced voltage. Piston will then return to its back position and stay there till a signal is received to make a subsequent turning-gear start. As turning gear approaches full speed, full voltage is applied to motor.

The turning gear continues to run until shutdown either by devices responding to time or temperature, or by pushing the stop button. Main compressor motors may be started

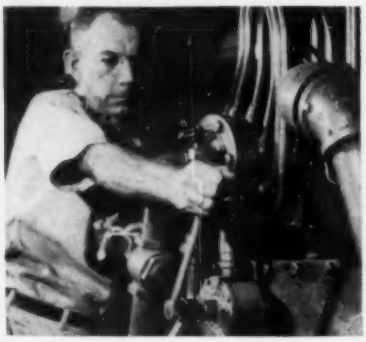
(*Continued on page* 210)

OPERATORS' NOTEBOOK 73

Let's Start Your Diesel

Getting Ready

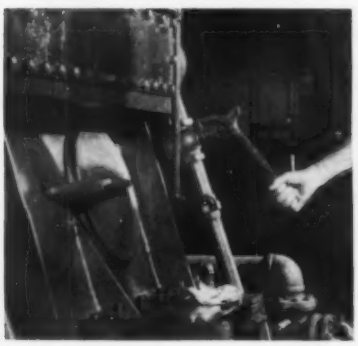
1 Open the inlet and outlet of engine's jacket and the cylinder-head cooling water, make sure water is flowing through



2 Pump up the lube-oil pressure by hand to about 5-10 psi. This prevents scored bearings caused by oil draining

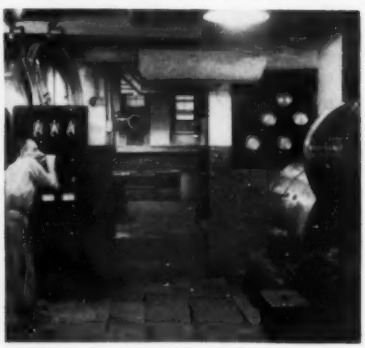
3 Open fuel valve and pump up fuel by hand to make sure lines are filled, and also to help clear the lines of air

Starting Up



7 Open starting air-valve to crank the engine, close valve as soon as engine is firing and rolling under own power

8 Test cylinders for water by holding a dry rag under open-cylinder blow-off valves. If moist, check for cracks



9 Bring speed up slowly. If cold, wait till lube is 100 F. Observe oil, fuel, cooling pressure, and then throw on load

Keeping on Your Toes

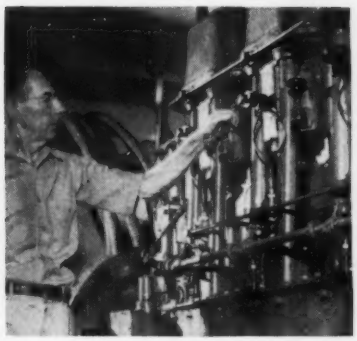
13 Check bearing and other temperatures every hour. Do this by feel as shown, and by reading the various gages

14 Every hour, oil starting air-distributor (this engine). There are various oil cups that need hourly hand oiling

15 Check voltage and load every hour, jot down on log sheets. This practice is often skipped in small plants

Engine and Keep It Rolling

By **STEVE ELONKA,**
Associate Editor



4 Open blowoff valves of each cylinder to avoid any damage if there is water in the cylinder from a cracked liner

5 Open starting-air valve on storage tank if the pressure is right for starting. If not, start the air compressor

6 Set the governor to starting speed. This engine is now ready to start as it has been properly prepared to roll

10 Check exhaust temperatures of all cylinders with selector switch as shown. Do this before leaving engine

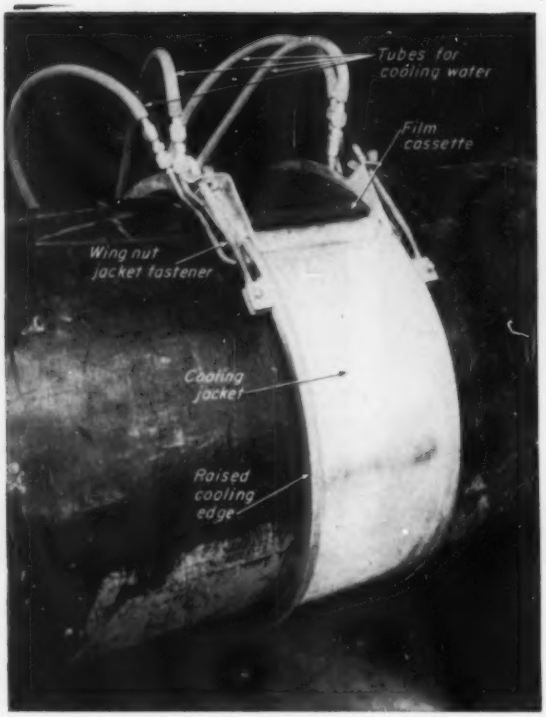
11 Exhaust of this cylinder is very low because of air in the fuel-oil line. Crack connections and let air bleed out

12 If venting the fuel-line won't help, shut it down and replace the fuel injector because the unit is probably faulty

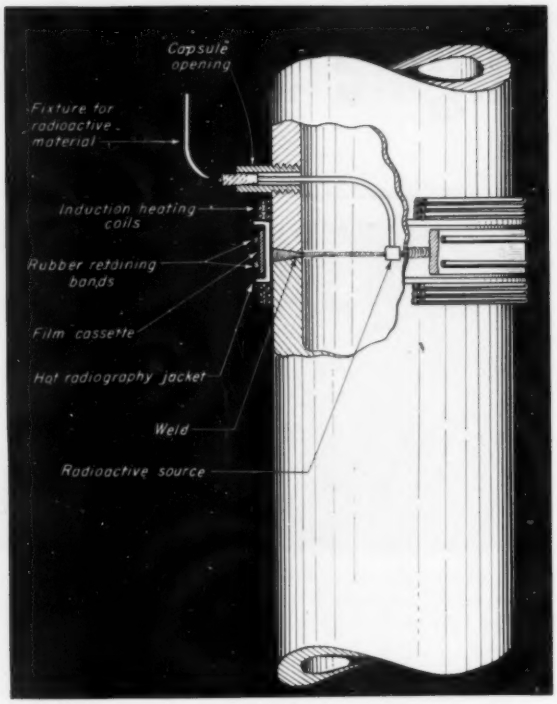
16 Every hour, log exhaust temp, cooling-water temp in and out, lube-oil temp in and out, lube-oil pressure in, out

17 Once a day, fill wick oilers for rocker-arm rollers, exhaust and also intake valves, etc, depending on engine

18 Enter time engine was started, or shut down and other important info in log book. Sign when going off watch



COOLING JACKET clamped around pipe protects X-ray film from high temperatures while the radiograph of weld is being made



FIXTURE for holding the capsule of radioactive material fits through pipe opening near weld. Diagram shows other details

New Hot Radiography Process Cuts

By **ALEXANDER GOBUS**, *Metallurgist, Sam Tour & Co, Inc*

- **Controlled cooling of weld before taking a radiograph is not needed with this method**
- **Postheating to relieve internal stresses is also unnecessary with new technique**
- **Excellent for high-pressure high-temp power piping, it is also good for other jobs requiring X-ray inspection of welds**

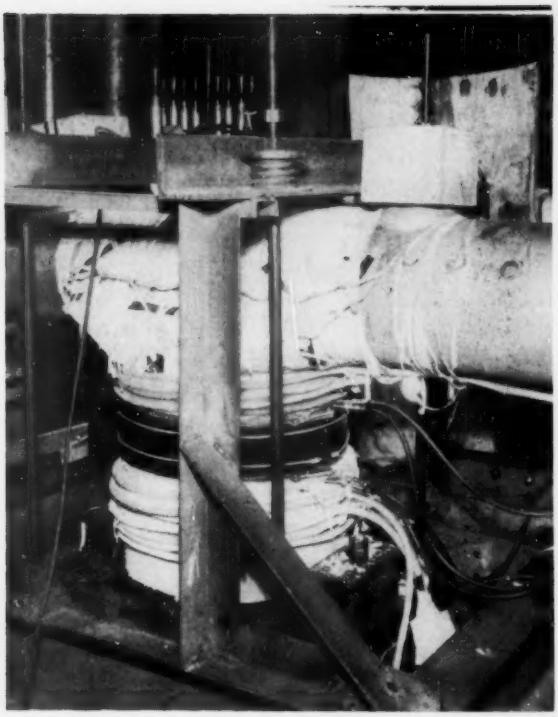
► ORDINARY RADIOGRAPHY techniques waste much time and labor during inspection of welds in certain types of alloys. An interesting new process appears to bypass this objection, yet furnish equivalent analysis.

Radiographic inspection for flaws at progressive stages in the welding process often saves removing an entire joint weld. But the conventional procedure is a major undertaking because the weld must be cooled before taking the radiograph. Industrial X-ray film is vulnerable to temperatures higher than 100 F. Welds at temperatures as high as 600 F, require time-consuming techniques for successful results.

Long postheating, to relieve internal stresses before controlled cooling begins also introduces problems. After radiographing the cool weld, many more hours of preheating are necessary before welding can be resumed.

Hot radiography, the McElroy-Mc-

TO RADIOGRAPH pipe joint, welding is stopped, cooling jacket immediately clamped around pipe and the water flow started



WHEN JACKET is cool, three film cassettes are held in place by rubber fasteners. Each radiograph here took less than 1 hr

Pipe-Weld Inspection Time by 50%

Nutt process, makes it possible to take weld radiographs without first cooling the metal. The advantages of the method, licensed exclusively to Sam Tour & Co, Inc, are most striking when applied to alloys requiring a cycle of postheat, controlled cooling and preheat for each radiographic inspection. For example, this process reduces the total time needed to weld pipe joints in high-temperature steam lines by about 55%.

Equipment. Watercooled jacket, *left photo, facing page*, protects the film from high temperatures. Jacket consists of two hollow cylindrical sections hinged at one end and fitted with wing-nut fasteners at the other. Pipe connections provide an inlet and outlet for the cooling fluid. Hollow, raised sides of jacket help maintain an even temperature distribution along the surface in contact with the film cassette. Heavy, rubber retaining bands hold the flexible cassettes in place.

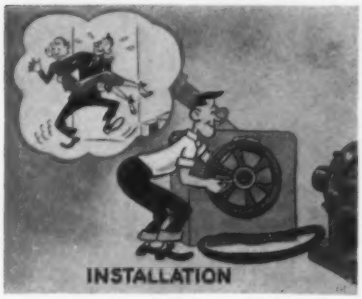
To take a radiograph of a hot pipe weld, the jacket is placed between the induction heating coils and clamped around the pipe. After cooling water is circulated for several minutes, three cassettes, covering the circumference of the pipe, are fastened in place. Gamma radiation, from a source held at the center of the pipe, penetrates the weld and forms an image of its structure on the film.

The whole operation in this process is conducted at preheat temperature. Welding is interrupted for only about 30 minutes, depending on weld thickness and exposure time required.

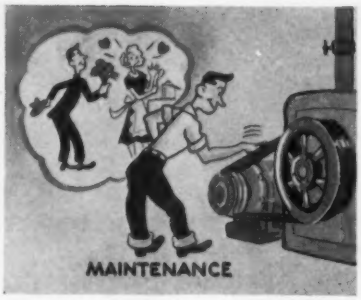
Special jig, *right sketch, facing page*, holds radioactive material at center of the pipe. Jig arm fits through an opening near weld. When the joint is completed, a plug of the same alloy as the pipe is screwed into the opening and welded to the outer pipe surface. When the weld is near the end of the pipe, other methods are used to introduce the gamma ray. But the jig allows accurate positioning of the source when other setups are not applicable.

Using the cooling jacket increases the distance between source and film by about ½ in., introduces two thin sections of steel before the film, and adds a layer of water that must be penetrated by the radiation. These have no observable effect on the radiographs and are permitted by the boiler code. Penetrameter sensitivity with the new method is at least 2%. This accuracy is equal to that of the conventional method and is well within ASME Power Boiler Code requirements.

Results. For a typical joint in 3-in.-thick 17-in.-OD 2¼%-chrome 1%-molybdenum steel pipe, hot radiography cuts total welding time 94½ hours. This new process is also suitable for other jobs, be they cylindrical or other shape. Savings in time are high, too.

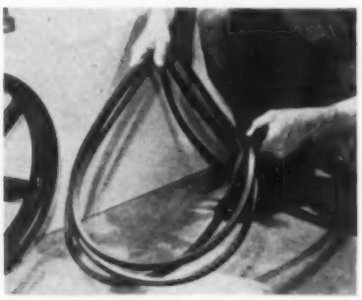


1 Installation. Whether it's the right bride, the right groom, or the right drive, proper selection and installation are very important steps. You have to get off on the right foot if you want to stay happy with your selection and still keep out of operating trouble as you go along

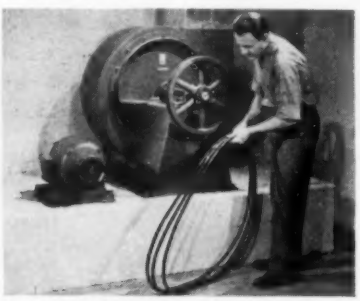


2 Maintenance. Once your installation is complete, proper maintenance will keep it running correctly. The rules are simple but they must get careful attention. Following are the highlights of good procedure for either installing new belts or replacing the worn ones

3 Check the grooves if sheave has been used previously. Look for wear, roughness and pitting. When making replacements, examine the old, damaged belts. Slip burns, snub breaks, broken cords, scuffing, oil deterioration or abrasion give you clues to what needs correction



7 Replace whole set of belts at one time, even though only one is damaged. Old belts will have stretched and be longer than the new. If you put in only one new belt it will carry more than its share of the load and will break long before you have received full value from it



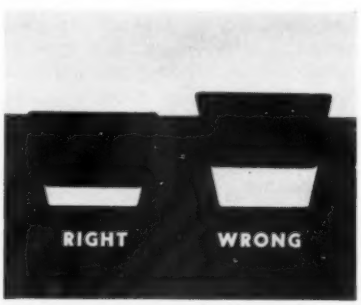
8 Check belt length to be sure all are the same. If lengths vary, some will be too tight, others too loose. The tight belts wear out quickly, while the loose ones slip and burn from the heat of friction against the sheaves; the belt loses shape and interior gradually deteriorates

9 Code numbers must fall within a range of one number for each 100 in. of belt length. This gives you a matched set of belts that will run well together. If the belt length is between 100 and 200 in., it's all right to use code numbers within a range of two; from 200 to 300, range of three

How to Install and Maintain

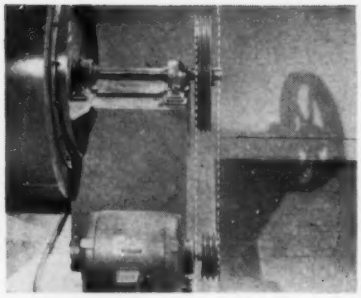
V-Belt Drives

Proper selection, careful installation, efficient maintenance are the elements of good V-belt service. These 16 photos, from Allis-Chalmers new slide film series, highlight the do's and dont's of V-belt installation and maintenance

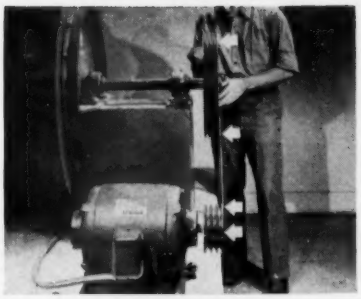


13 Check side contact. If belt is too loose, it rides up and out of the grooves, greatly reducing both the area of contact and pressure against the sides of grooves. Belt must be in proper position to produce a good wedging action against the sheave and transmit full power

4 Install the sheaves on motor and driven-machine shafts. Be sure both bore and shaft are clean and free from nicks so the sheave will slip on easily, and align correctly. Follow the manufacturer's recommendations for the simplest and best mounting procedures for any size sheave

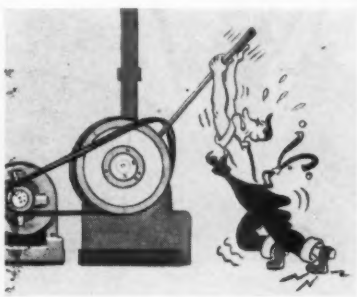


5 Check sheave alignment. Get the approximate positions by aligning by eye. If sheaves are very much out of line you will have unbalanced side pressure against belts where they leave and enter the grooves. In time, this causes appreciable wear on both belts and sheaves

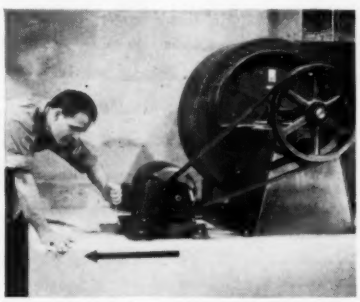


6 These points tell whether sheaves are aligned and shafts are parallel. A piece of string or a straightedge should contact both edges of both sheaves. After making one check, rotate sheaves 90 deg and check again. Perfect alignment at the start prevents trouble later when drive is running

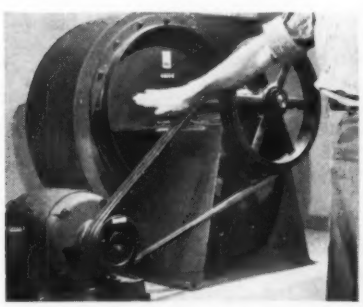
10 Mount belts on sheaves. Shorten center distance by moving the motor base as close to the driven machine as possible. Then slip belts over the sheaves. Seat belts in grooves by turning the drive over a few times and check to see that it runs in the right direction



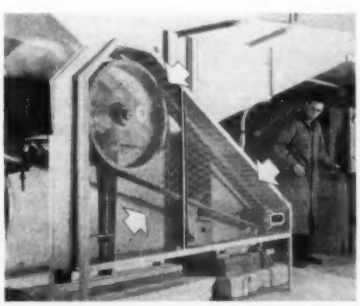
11 Don't pry V belt into grooves. This method can easily result in over stretching and breaking the inner pulling cords. Belt will start to pull apart at the inner cord break. Avoid this type of damage by using the proper, easier installation method described in photo 10, *left*



12 Adjust tension. This is a highly important factor in multiple V-belt drives. To get the right tension in a new belt, pull the motor back until any apparent slack is removed. Then move the motor back an additional ½ in. for every 100 in. of center distance between the shafts

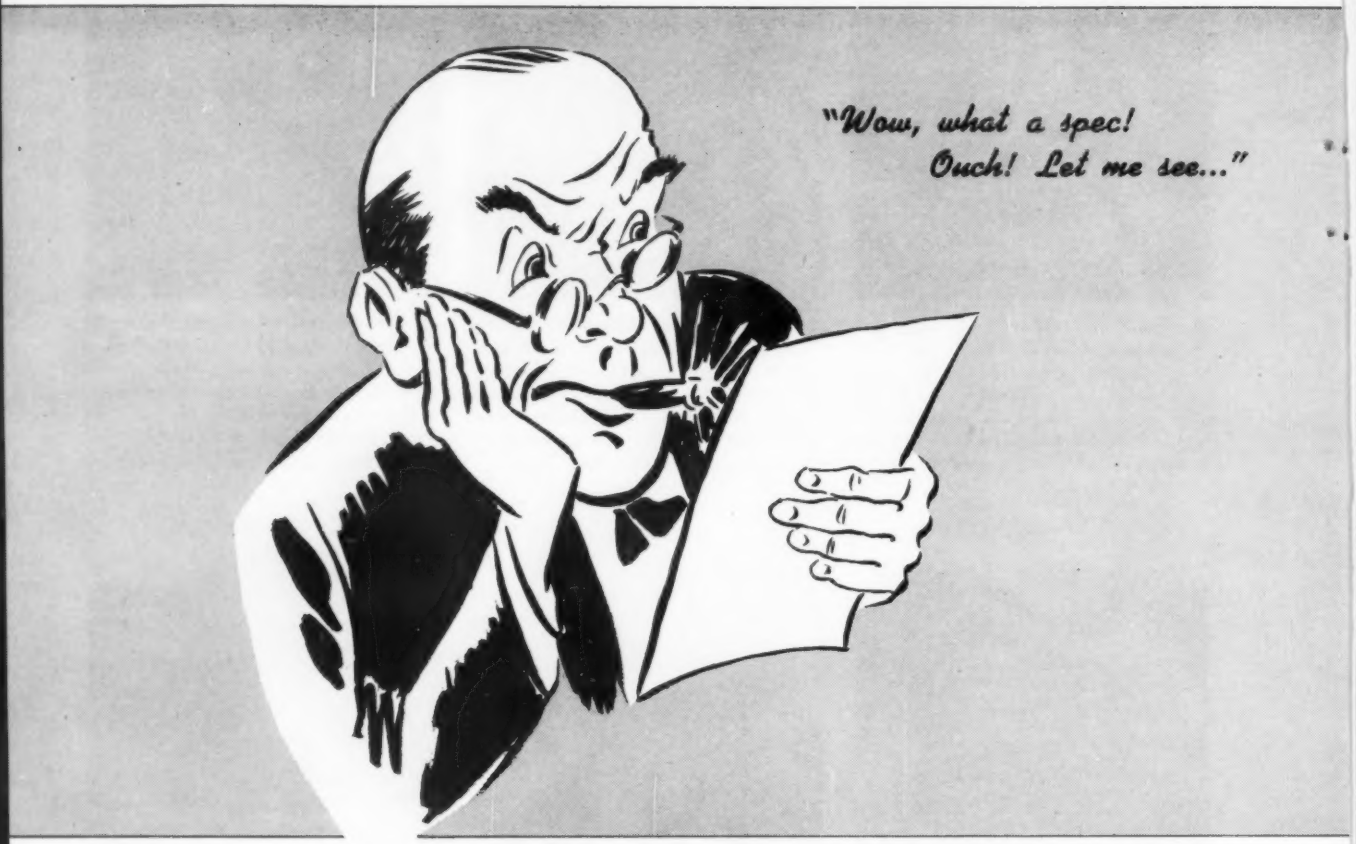


14 Check tension during run-in. When you slap belt sharply with the hand, it should feel springy and alive. If it feels lifeless, tension is too low. Check several times during run-in as belts may stretch. And check periodically throughout life of the drive to insure proper tension



15 Install a guard for the safety of personnel and for protecting the drive against falling debris. Use an open-type guard to allow heat to escape, and install splash guards where there is oil. Be sure there is enough clearance all around so the belts do not rub on guard

16 Watch out for the unguarded V-belt drive. You can easily tear clothing, get a bad burn, or mash your hand. Ordinarily, all you need to prevent these accidents is a simple guard that almost anybody can install. But be sure you have the right type. See photo 15, *at the left*



Trouble-Shooting an Air-Conditioning Job

The specs were bad from the start, but it took some detective work to learn where the trouble was. C T Baker of Atlanta, Ga., tells how he worked

► POORLY PREPARED specifications can give a plant operator some of the worst headaches he'll ever know. This is especially true when the spec writer runs his job by what I call remote control—that is, from an office desk where he never sees the inside of the plant or meets its crew.

POOR SPECS, POOR JOB

A recent air-conditioning job points up these facts neatly. Here's an exact quotation from one of the most important paragraphs in the spec. It was supposed to be written to cover the compressors needed for the job:

> Furnish and install where indicated on the drawings two complete refrigerating machines using an approved nontoxic nonirritant and nonflammable refrigerating medium. Each refrigerating machine must be a complete unit with compressor, motor, condenser, water cooler, auxiliaries, piping, valves, etc. Each unit shall have a capacity of not less than 12 tons of refrigeration per 24 hours when operating at a temperature to produce 45-F chilled water when supplied with condensing water at 87 F at the rate of 5 gpm per ton and with a head temperature of 108 F and a suction temperature of 35 F.

The quoted paragraph lacks clearness and continuity; its definition of the tonnage needed for the job is ambiguous. Why go to all the trouble to specify a nontoxic refrigerant when Freon-12 suits reciprocating compressors so well, and F-11 is good for centrifugals? No others would qualify for this job. Also, since the specs clearly indicate that two reciprocating compressors are to be purchased, why not state this? Many useless words could be eliminated.

Builders of refrigeration and air-conditioning equipment are never impressed by what I call hogwash in specs. State what you want as clearly and concisely as possible.

Note that each compressor is to produce 45-F chilled water with a suction temperature of 35 F. The first question that arises in my mind is: How much water is to be cooled every hour? What is the cooling range? The operating engineer must know the design inlet and outlet temperatures for the

chiller if he is to obtain best results. These facts are not given in the spec as now written.

No fouling factor is specified for the chiller. Nor is the bidder asked to state the effective tube-cooling surface for the coolers and condensers. Spec neglects compressor's cylinder dimensions, rotative speed and other important items. Without these facts it's difficult to compare bids from different manufacturers of suitable equipment.

Comfort conditions (temperature and humidity) were not clearly stated in the specs. For example, after setting up values for minimum and maximum outside air for each office and assembly room, the specs say:

> The apparatus shall be designed to function with the full amount of outside air, with the minimum amount, or with any amount between these two extremes.

Though the specs called for indoor conditions of 80 F and 50% relative humidity when outdoor dry bulb was 95 F and wet bulb 75 F, the actual levels reached in the section of the country where the plant is located are 78-F wet bulb, 98- to 100-F dry bulb.

The summer vacation prevented running a full-scale acceptance test but conditions in a preliminary test were:

	Outdoor	*Indoor*	
		Space A	*Space B*
Dry-bulb temp, F	91	84	82
Wet-bulb temp, F	81	78	76
Relative humidity, %	65	77	76

Plant suction pressure was as low as 22 psi with a corresponding temperature of 22 F. Chiller inlet temperature was 78 F, outlet 36 F. These conditions showed something was radically wrong. Suction pressure and temperature and chiller exit temperature were way out of line.

OPERATING TROUBLES

When I stopped in to check the plant, the operating engineer told me one of the shell-and-tube coolers froze and burst a few weeks earlier. Checking each chiller's circulating pump showed it handled only a small amount of water.

We shut down one of the pumps and opened its suction strainers. The strainers were almost completely blocked by chips, shavings and other dirt left by workmen remodeling some of the spaces in the plant. This condition explained why such a large temperature reduction was taking place in the chillers. Since only a dribble of water reached them, the refrigerant absorbed a large amount of heat, giving an outlet temperature close to freezing.

Low-temperature cutouts, intended to stop the compressor automatically when water temperature dropped too low, were incorrectly wired. So the outlet temperature continued to decrease until the water froze and burst the chiller. Not only was the chiller damaged, a large amount of Freon was lost.

To protect the strainers, we installed a pressure gage on the inlet and outlet. These permitted operator to see at a glance just what was happening in the strainers.

A further look around showed the strainers on the condensing-water pump were just as badly clogged. Ditto for the compressors and one strainer on an evaporator liquid line.

Checking further, we learned the refrigeration contractor neglected to remove and clean the strainers before turning the plant over to the owners. He also overlooked instructions on strainer maintenance for the operators.

The job specs didn't call for liquid receivers, so none were installed. The operator had no means of checking how much Freon was in the system, though he did know it must be quite low because so much was lost when the chiller burst.

But even with an inadequate refrigerant charge, a second test showed much better performance than the first. Suction pressure of one compressor was 36 psig, of the other 38 psig. Water entered one chiller at 56 F, left at 52 F. Inlet to second cooler was 55 F, outlet 51 F. Outdoor temperature during second test was the same as in the first one. Dry-bulb temperature in air-conditioned spaces fell to 74 F, wet bulb to 66 F, without room occupants.

No Freon Dryers. Specs neglected these items, even though they are considered standard and are furnished by most contractors. Without dryers there is no way of removing moisture from the liquid refrigerant.

Valves Missing. Chillers couldn't be isolated from the compressors because no stop valves were fitted in suction line to the chillers. So if compressor suction valve leaked during shutdown, there was no way of stopping Freon loss.

CORRECTING THE FAULTS

I made six recommendations designed to clear up the troubles in this plant. All were accepted and acted on.

1. Install two liquid receivers, each fitted with a gage glass, inlet and outlet liquid stop valves, and dual safety valves of suitable design and capacity.
2. Rewire the automatic cutouts for the compressors.
3. Install a backpressure regulating valve to maintain a constant evaporation pressure in the chillers. Fit the valve with a full-size bypass and strainer. Valve provides additional nonfreeze protection for the chiller.
4. Install suitable dryers in liquid lines to remove moisture. Fit with full-size, valved bypass.
5. Fit a hand-operated stop valve to the suction outlet of each chiller in the plant.
6. Provide a ventilating fan for plant attic. Locate suitably-sized louvers so air flow is free and unobstructed.

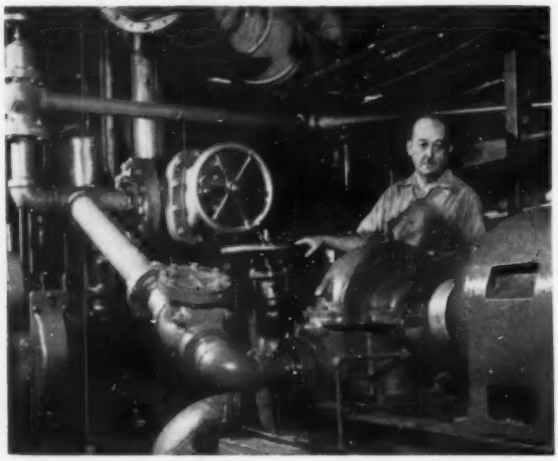
Is Your Plant a Candidate for *Power's* MODERNIZATION AWARDS?

As announced on page 94 of this issue, POWER will cite those who have completed an outstanding modernization job in their powerhouse or plant proper. If you have renovated during 1952 or 1953, and feel quite proud of the job, here is your opportunity to have your skill and judgment recognized.

Results in those plants doing a top modernization job will be made known through POWER's pages. And plants selected for such accomplishment will receive a citation testifying to that fact —a citation that may be proudly displayed in your plant or office for all to see.

Renovation may involve the entire power-service system or any major part of it—in industry, institution or utility. Entries may be submitted by power-service staffs or consultants for their clients. To enter, simply write to POWER asking for a 1954 Modernization Award blank. Address your card or letter to Modernization Awards, POWER, McGraw-Hill Publishing Co, 330 West 42nd St, New York 36, New York.

Latest PRACTICAL IDEAS *to slash your skyrocketing*



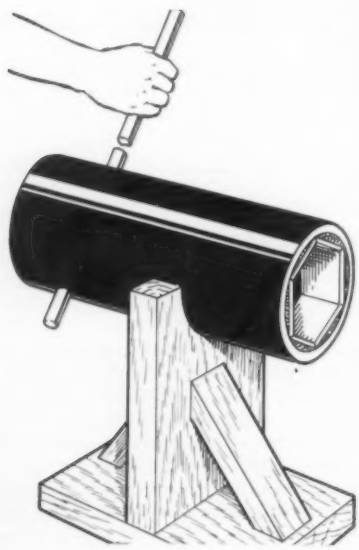
New Motor-Driven Pump Saves Backpressure

FOR 47 YEARS, our two ancient, steam reciprocating pumps supplied 140-psi hydraulic pressure for our two high-speed elevators. Their exhaust steam supplied our heating system, as did exhaust from other pumps and one large uniflow engine that generates electricity.

Because of old age, one pump used more steam than necessary. That caused us to blow excess steam out through the roof vent. We figured it was cheaper to install a new 60-hp 2-stage motor-driven centrifugal pump than to repair the old unit. This pump is tied into our old system, *photo*, and is supplied with ac current from the public utility that we are hooked up to for emergency reasons. This hookup assures us elevator service if our generator breaks down.

Now, our problem of excess exhaust steam has been solved as there is no exhaust blowing through our vent. We figure the new pump and motor will soon pay for themselves in saved waste steam, more reliable elevator operation.

H ERDLE *New York, N. Y.*



Socket Wrench and Stand For Large Steam Engine

PISTON-ROD NUT on high cylinder of our cross-compound engine gave trouble by working loose and pounding at end of stroke when piston came up against nut. Rod diameter is 4 in., nut 6⅛ in. across flats. Our chief millwright made a tool that did the job quickly and easily.

He cut six pieces of ⅜-in. steel and welded to form hexagon, sketch. This was fitted into one end of length of 8-in. standard steel pipe, 18 in. long, welded at both ends. Outside of welds was trimmed off by grinding.

Two 1-in. holes were drilled diametrically through other end of pipe, 90 degrees apart for a bar.

To support free end of wrench they made a stand of 2-in. hardwood plank, 10 in. wide and about 18 in. long.

A H MOULTON *Pittsfield, Mass.*

Blow Your New Pipelines So They Are Really Clean

NEW PIPELINES must be blown. Besides rusting inside, during erection, they collect rubbish, such as rags, paper, tools, welding rods, pieces of wood and gravel. Or a disgruntled workman may leave or put rubbish inside lines.

In cleaning most pipes nothing is found, but sometimes rubbish is removed that would cripple operation. Sand and gravel can seriously damage running machinery.

Most lines have ¾-in. drains at various points. You can't get enough velocity through these drains to do much good. Small lines under 2 in. can be cleaned by letting air, water or steam blow through the drain. But you can't clean a line unless velocity during cleaning exceeds maximum velocity in normal operation. So disconnect line by removing a valve, spool piece, elbow or tee at point where it's to be blown. Or spread flanges at point of blowing, if pipeline is flexible enough to spread flanges for required area. For a 6-in. pipe, spread apart 1½ in. for full area. Where flanges are spread out, insert a blank to prevent rubbish entering downstream section.

For blowing lines at full flow, time needed is very short, about 10 minutes. But preparing to blow may take many hours.

First, decide point where line should be blown. Blow equipment not only where line ends, but also all points between exchangers, orifices, control valves, etc. If these points have bypasses, blow around each bypass.

Another point is where valve blowing will be regulated. Regulate blowing at farthest upstream valve. Globe is best because larger gate valves are hard to open and close. Have all downstream valves wide open. Then there will be a sweeping action. Steam or air causes expansion to produce a greater velocity.

For many lines, even two minutes of continuous blow at full rate is impractical. Why? If water is used, it floods the floor; if steam, it fills space with steam. If line is blown outdoors, you may lose large amounts of steam or water. Usually steam or water is not available in large quantities.

So it's more practical to blow for short periods of one minute or less; repeat as often as required. Usually, second one-minute blow comes out clean, showing further blowing is not

needed. Or you may have to go to more than five one-minute blows at full rate, before all dirt is out. For convenience, blow water lines with water that's normally used in those lines. Then no extra piping is needed. But provide disposal of waste water. If line is large, even one-minute blow at full rate will flood the floor. While waiting for water to drain, you can give as many one-minute blows as needed.

Protect equipment that can be damaged. If you can't run water on floor, pipe waste-water to nearest drain. When water lines normally contain condensate, blow with raw water, then recirculate condensate until lines are clean.

Blow steam lines with steam. If line is blown outdoors, blowing can be continuous. Short, intermittent blows are usually best because great quantity of steam needed pulls down system's pressure. Several one-minute blows at full capacity clean a line thoroughly. If you can't use enough pressure, even blowing for several hours may do a little good. By taking precaution, steam lines up to 3 or 4 in. can often be blown indoors. Then wait between blows for steam to clear from space before repeating.

Air lines are easiest to blow with air. Use repeated short blows because air-system capacity is limited for sustained blow at high rate needed to do good scrubbing. Before blowing air lines, hammer them.

Process lines that normally carry liquid or gas hydrocarbon and other liquids or gases are hardest to clean. They must have air or water needed for cleaning piped to them. Usually the large amounts needed for high velocities aren't available.

If vessels are attached to a line, it can be blown by building air pressure in vessel to full available pressure. Then release through line as fast as valve can be opened. This valve should be at vessel, with all downstream valves wide open. Before blowing, hammer lines. You may even have to run them through.

If vessel is not attached to a line and if large amounts of water or air cannot be easily piped for high enough velocity, clean line by first filling low spots with water. Then blow off water, thus saving as much air as possible. Repeat until water comes out clean.

Does all this sound like a lot of trouble? Well, it is. But unless you know what you're doing and do a lot of work, new lines can wreck your plant.

N T Pef *Wallaston, Mass.*

What Would You Have Done?

Nut-securing low-pressure piston on a large tandem compound engine in our plant worked loose. To reach nut, we had to disconnect steam and exhaust lines, valve gear and piston from high-pressure cylinder and chest. So we had to remove this unit, the connecting casting and also the low-pressure head. Handling these sections (some weighed 1500 lb) without a crane in a temperature of 115 degrees was some chore.

After working a 12-hour day, we started at 6 pm. At 3 am the job was finished. Only the main rod had to be repacked. "You fellows go home so you can return by 6 am," I directed my three assistants. "I'll take care of the rod and try her out."

I started replacing the rod packing, then made a discovery that nearly floored me. We had forgotten to slip the gland over the rod before reassembling the engine after all that work.

Faint from shock, and exhausted from the 21-hour session in that heat, I went out in the cool night air to try to think. And some mighty tall thinking was needed—that engine had to be rolling by 7 am.

Replacing the gland by tearing down and reassembling the engine was out of the question. Finally, after going over many possibilities, I decided to split the gland into halves and screw it together over the rod. It meant sawing through a total of 18 cubic inches of tough semi-steel with a hand hacksaw, then drilling and tapping eight 3/8-in. holes to hold the split gland together. But I finally had the engine ready for the boys a scant 30 minutes before the dead line.

M A Jensen *Lincoln 3, Neb.*

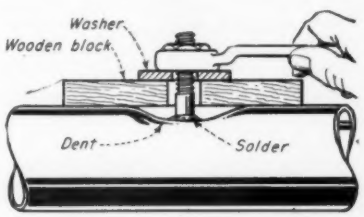
Editor's Note: Power *will make it worth your while to send in items for "What Would You Have Done?"*

Single Conductors Cut Your Cable Costs

Like the proverbial snake that isn't seen until it strikes, items that are just as obvious are often overlooked in plant modernization. We were installing 3-conductor cables when the supply ran out. Then we found it more economical to install single conductors. Three individual wires save almost 25% over an equal cable. But voltage drop zooms if you exceed current rating.

Trench expense is identical when three singles are laid on 6-inch centers. In case of a fault, one single conductor can be spliced faster and cheaper than a 3-wire assembly. Also, a break in a single lead usually will not damage the other two wires, as in a cable.

L W Fitzpatrick *Jefferson City, Mo.*



Removing Dents From Copper Piping Is Easy

Dents can be removed from copper piping by cleaning and tinning the bottom of dent. Then solder a threaded copper stud as shown. Tighten the nut until the dent has come out.

W E Warner *Woodford Green, Eng.*

(*Continued on page* 134)

More PRACTICAL IDEAS

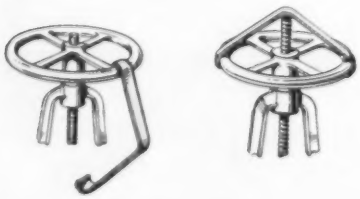
Begins on page 132

Handy Metal Pick-Up

WHAT'S THIS slick chick doing in a maintenance shop? Well, it's this way. We thought you boys might want a little "glammer" in POWER now and then. She's demonstrating a detachable magnet element that can be used for lifting small pieces out of bins and off the floor. It has a hundred other uses, too. For example, when you drop a nut into the cylinder just before bolting down the cover, tie this magnet to a cord and up comes the nut without taking the engine apart.

This is a powerful Alnico V-magnet tube that fits into a sweeper (fits between wheels of that gadget you see in photo). It retrieves fine ferrous material, is used as a skimmer or coolant cleaner, as an underwater recovery magnet, or as a magnet collector in any hard-to-get-at places. Powerful magnetic action of tube is guaranteed forever.

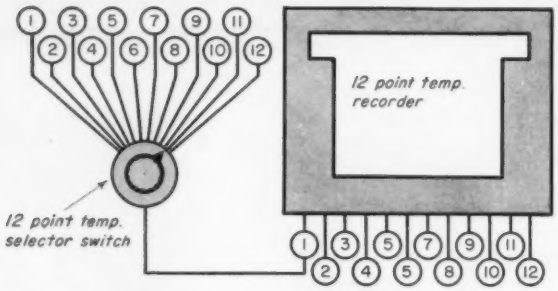
For more info (on magnet, not the gal), write to Eriez Mfg. Co, Erie, Pa.



Guard for Stems

WE PLACE a metal guard on rising valve stem to prevent it snagging the operators' pockets or other parts of clothing. Pressure of the stem holds the guard tight. Hang on valve wheel when closed.

S KRONE *Canby, Minn.*



This Process Temperature Indicator Costs Less

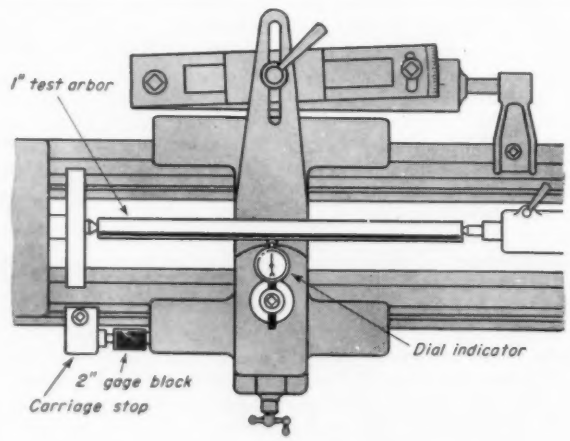
BECAUSE FUNDS for our new chemical plant were limited, we were forced to scrimp, especially on control circuits. We came up with a device that saved many dollars, yet sacrificed as little control sensitivity and accuracy as possible. My sketch shows one such item, which should interest POWER readers.

Customer wanted a process temperature recorder with 10 different points, continuously recorded, another with 10 different points, irregularly indicated. Our proposal was the instrument shown with 12-point temperature recorder and a 12-point temperature selector switch.

Selector switch is wired to one point on recorder, leaving 11 points for continuous recording. This gave one spare point for recording and two spare points for indicating. You can see the many variations possible in this hookup. Only limitations are the number of continuously recorded points required, and range of the recorder.

Main disadvantage of circuit is that indicating points cannot be read instantaneously, but are governed by time cycle of the recorder. In this case customer was more interested in savings resulting from omission of a 12-point expensive temperature indicator.

R L THEISS *Akron, Ohio*



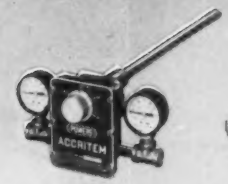
Quick, Accurate Taper Setting With 2-In. Block

USE A STRAIGHT ARBOR, dial indicator and 2-in. block against micrometer stop, *sketch*, to set taper attachment accurately. First, place straight arbor between lathe centers. Set dial indicator in tool post with contact button touching the arbor and dial needle pointing to zero. Place carriage stop exactly two inches from present carriage position with the 2-in. block as shown. You can use any piece of 2-in. metal for this.

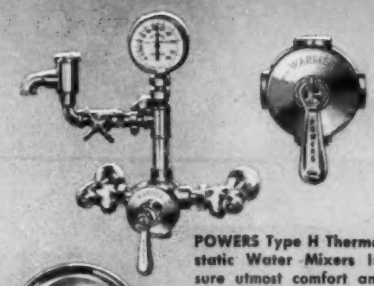
Adjust taper attachment so dial indicates exact number of thousandths per inch needed when block is removed and carriage travels two inches. Reason is that taper attachment is moved only half of taper to be cut. Shaft revolving has that amount removed from both sides. Therefore, carriage movement of two inches shows taper per inch.

B A ROGERS *Hopedale, Mass.*

(*Continued on page* 136)

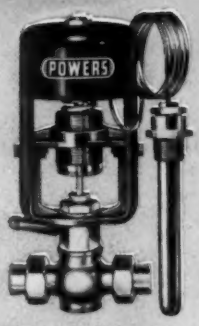


Above: POWERS ACCRITEM Temperature Regulator, is water or compressed air operated. Controls FLOWRITE diaphragm valve (right). Widely used for Water Heaters and Industrial Processes.



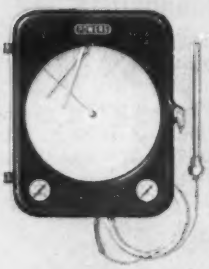
POWERS Type H Thermostatic Water Mixers Insure utmost comfort and safety in showers and other types of baths.

Also used for many processes. Users report ½° F. ± accuracy. Capacities 5 to 10 gpm. @ 45 psi.



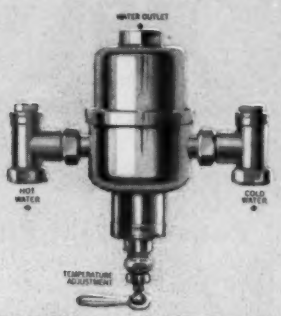
Powers No. 11 Self-Operating Regulator widely used for water storage heaters, heat exchangers, fuel oil preheaters and many industrial processes.

WATER Temperature CONTROL?

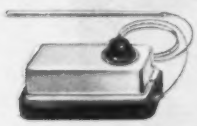


Powers Series 100 Recording Controller. Compressed Air Operated.

POWERS FLOWRITE V-Port-Characterized Diaphragm Control Valve.



Powers Thermostatic Water Controller for regulating temperature of mulitple type showers, hydro-therapy and industrial processes. Capacities 22 to 125 gpm. @ 45 psi.



Powers Remote Bulb Type D Thermostat for Unit Air Conditioners.

POWERS **PACKLESS** VALVES

For controlling chilled, or heated water in unit air conditioners.
No leakage
No packing maintenance

Call POWERS

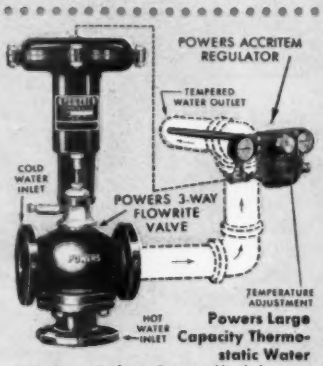
Most Complete Line of Controls Made
Only a few are shown here

for All Types of Baths, Water Heaters and Heat Exchangers

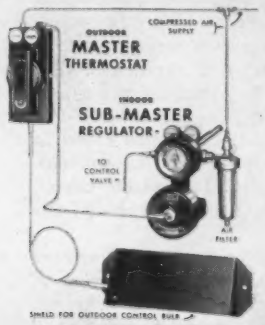
- Forced Hot Water Heating Systems
- Radiant Panel Heating Systems
- Air Conditioning Units using Chilled and Heated Water
- Cooling Water for Air Compressors, Diesel, Gas Engines, and Cyclotrons
- **Many Industrial Processes:** Photo Developing, X-Ray, Color and Ordinary Film, Lens Polishing and Grinding, Chocolate Enrobers, Plastic Molding Presses, etc.

Our More than 60 Years Experience will be valuable in helping you select the right control for your requirements. Contact our nearest office or *Write us direct for Condensed Catalog Rb 24.*

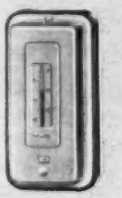
THE POWERS REGULATOR CO.
Skokie, Ill. • Offices in Over 50 Cities in the U.S.A., Canada and Mexico

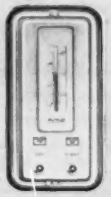


Powers Large Capacity Thermostatic Water Mixing Valve Controlled by an ACCRITEM Temperature Regulator. Capacities 20 to 1200 gpm. @ 45 psi.



Powers MASTROL Control for regulating forced hot water heating systems.





Powers Room Type Pneumatic Controls for Radiant Heating-Cooling Panels, Convectors and Unit Ventilators. Valves are packless. No more packing maintenance. No leakage.

(b61)

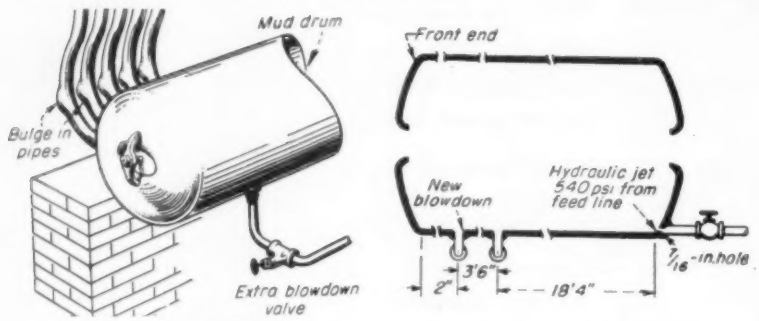
Begins on page 132

Rags Prevent Plugged Foundation Bolt Holes

WHEN POURING foundations for machinery, like diesel engines, common practice is to imbed large pipe in concrete around holding-down bolts, to give them movement needed for lining up engine.

Trouble is that liquid cement seeps into pipe, thus holding the bolts so they cannot be moved to fit into engine foundation holes. This trouble is easy to prevent, regardless of foundation size, or number of holding-down bolts. Just stuff old rags in all the pipes around the bolts. After concrete has hardened, remove rags with a long hook, photo.

FRED CARTER *Buffalo, N. Y.*



Now, No More Sludge in Boiler Mud Drums

WE HAD TROUBLE with mud drums on our new boilers. After four months of operation, inspection showed large accumulation of sludge in front ends of mud drums. But we had our worst surprise when inspecting inside of furnace.

Masonry and brickwork were excellent, but we found some 2-in. tubes badly bulged, sketch. They bulged where they leave mud drum and enter furnace. Trouble was mostly from sludge in front ends of drum. That restricted flow and insulated tubes inside. Longitudinal flow in those 18-in. diameter drums is toward the front.

To solve problem, we installed a second blowdown opening, two feet from drum's front end, sketch. By blowing both blowdown lines at intervals while boiler is banked, or at low loads, all sludge is blown out. We also installed a hydraulic jet, which proved very useful. One jet is in rear head of each mud drum. With 540 psi from feedwater line, it creates enough turbulence to move solids to blowdown orifices in 420-psi drum.

We reviewed sludge problem with our feedwater-treatment consultant. He advised treatment to keep solids in suspension. Now we use sludge conditioning for deposit that was mostly magnesium phosphate. This is a very sticky sludge, which bakes and burns on tubes.

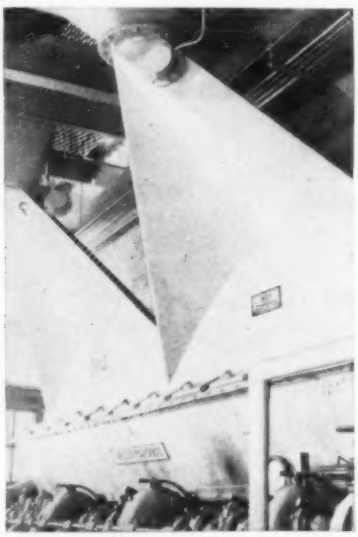
We prevent this trouble by maintaining a hydrate alkalinity of 170 ppm in boiler water. No more bulged tubes or clogged mud drums after two years.

J R BROWN *Bauta, Cuba*

Here's How to Lick Dry-Materials Handling

WE CURED a long-time industrial headache of controlling dry materials by installing level controllers.

Principle of controller is exact reverse of ball float used in ordinary toilet. Shutoff device goes down, instead of up. A compact, completely sealed housing is bolted on outside of storage bin. Housing has switch, connected with spring that's adjustable for sensitivity, which in turn is hooked to a rod running through a rubber sphere that's on housing side next to wall of bin. Ours is placed on the duct, as photo shows.



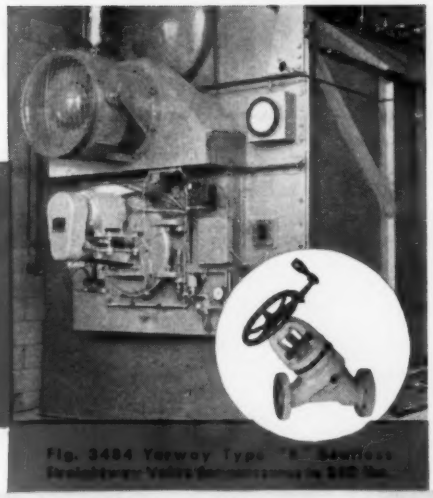
Rubber sphere is enclosed in housing that separates switch housing and interior of bin. Rod through flexible sphere bends downward inside bin, may be angled to any degree from horizontal.

Sensing probe is part that comes in contact with flowing material, and, moving freely through the flexible sphere, it works spring to throw switch that cuts off flow at desired level.

As sensing probe goes downward from weight of materials reaching it, electrical contact breaks, flow ceases.

E J SCRAY *Bound Brook, N. J.*

YARWAY MARCHES IN THE KEELER "PACKAGE" PARADE



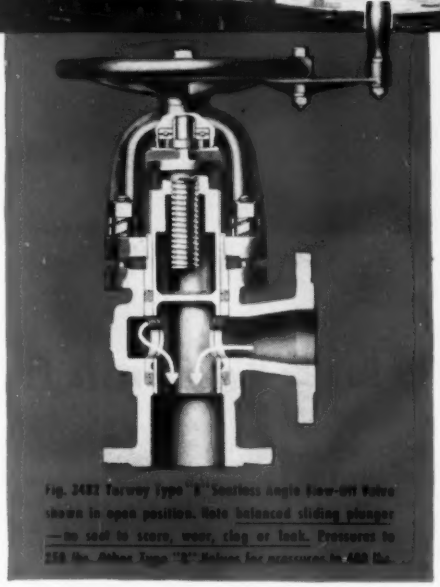
● Among other marks of quality on package boilers that "roll out" of E. Keeler Company's plant—are Yarway Blow-Off Valves.

Keeler knows what many other boilermakers know . . . that a *good* package-type boiler is *better* when equipped with Yarway Seatless Blow-Off Valves.

Over 15,000 boiler plant operators also know and appreciate Yarway Blow-Off Valves . . . their simplified design, dependable operation, long life, low cost maintenance.

Want more details? See Yarway Bulletin B-426.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.



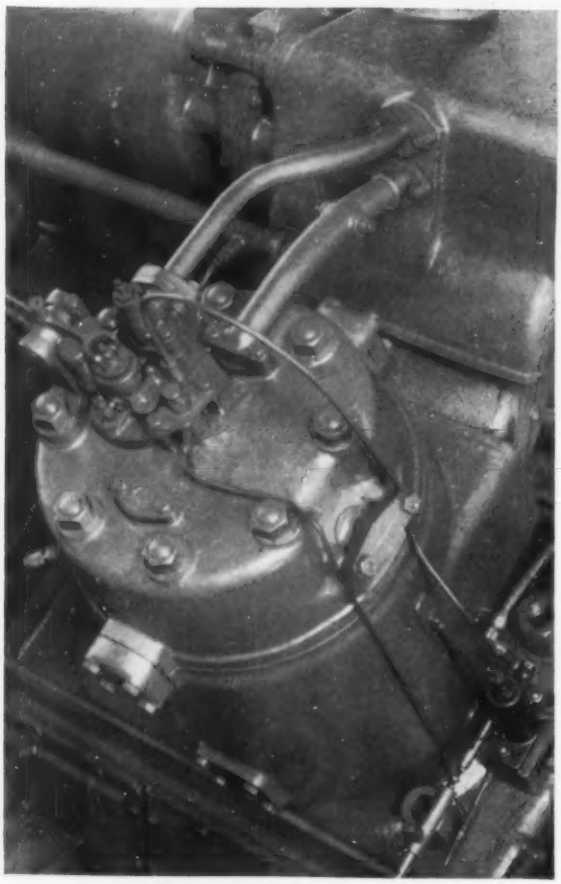
YARWAY

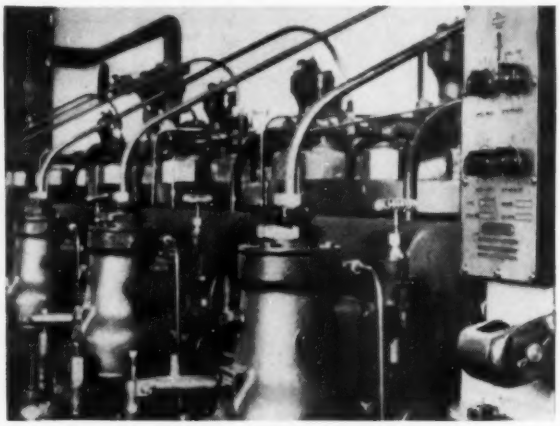
blow-off valves

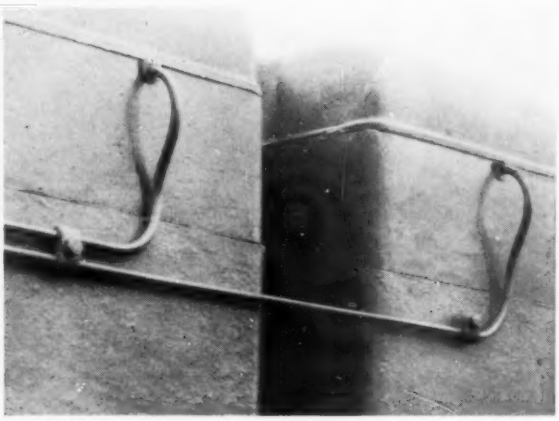
OTHER YARWAY PRODUCTS

HIGH PRESSURE BLOW-OFF VALVES
WATER COLUMNS and GAGES
LIQUID LEVEL INDICATORS and RECORDERS
EXPANSION JOINTS
STEAM TRAPS
STRAINERS
SPRAY NOZZLES
DIGESTER VALVES

PLANT PROBLEMS... *practical readers give advice*







TYPICAL successful fuel-oil tubing hookups that are used on several engines

Why Do Our High-Pressure Fuel Lines Fail?

HERE ARE THE FACTS: Our plant has three 600-hp solid-injection diesels burning No. 2 oil. They went on the line about two years ago. Performance is fine except for failures of high-pressure fuel lines between pump and nozzle.

Failures are of two types: (1) transverse break in the line near the nipple connecting to pump or nozzle (2) slow leaks. Leakage is sometimes followed by breakage of the line; at other times the leak just gets worse.

What causes these breaks and leaks? How can we cure them? Will coiling line into a loop help?—*JL, Jan Power*

Now read the answers ▶

PHOTOS, *above,* show various ways of running high-pressure (h-p) fuel lines between pump and injector. As you can see in these successful installations, smooth gentle bends are made in the lines to reduce the forces resulting from a change in direction of flow of the h-p fuel. Loops and bends absorb the slight expansion that occurs during discharge of the pump.

My experience with diesel-engine fuel-line failures shows that each line should be clamped to a rigid part of the engine at about the midpoint between the pump and injector. Where a coil is inserted in the line to equalize pipe length, neglect coil length when figuring midpoint.

Run lines so they are smooth and straight where they enter a clamp. Try

on diesel-fuel, superheated-steam lines

TYLER HICKS, *Associate Editor*

to keep line parallel to clamp opening if possible.

Be careful not to gash line ends when flaring for connection to pump and injector. Avoid twisting the line during installation. If a line is prepared for installation and you are unable to hook it up immediately, plug both ends or store in a bath of fuel oil. This prevents the start of internal corrosion.

DON KELLAND *New York, N. Y.*

LOOPING THE LINES may change injection timing, as diagram shows. *JL's* best bet is to install replacement lines carefully after checking rack base for solid anchoring. Install more clamps on fuel lines if they move appreciably.

HOWARD HOLCOMBE *Los Alamos, N. M.*

SOFT TUBING will not withstand the 3000-psi or higher pressures met in diesel service. Ready-made steel tubing supplied with all fittings is far better and has a much longer life. Sketch shows a typical installation of steel tubing on a diesel engine.

FRED ARDALINO *Brooklyn, N. Y.*

VIBRATION causes line failure. Movement of engine parts and pressure changes in the fuel lines cause the vibration in *JL's* plant. Clamps in the right places will stop line vibration but he may have to use trial and error to find which places are best for his engines. Loop or a long bend near the nozzle may stop the failures, too. A longer run between the nozzle connection and the first bend may also help because there is a greater length of tubing to take head vibration. Sketches show several typical hookups.

D L COCHRANE *Milaca, Minn.*

A RUBBER INSERT in the fuel-line clamp, as shown in sketch, cured our troubles. Clamps such as that shown can be purchased or made up in the plant shop. Though line may vibrate a little with this type of clamp, the major movements are restrained to nominal values.

JIM SPARKS *Chicago, Ill.*

SHORT, RIGID LINES are less likely to break than long, poorly supported ones. Normal engine vibration can cause leaks at nipples and, eventually, breakage. Coiling the line into a loop will not solve *JL's* problems; instead, it will only increase the length of line subject to vibration. Check couplings at each end of the line to see they are pulled up equally tight.

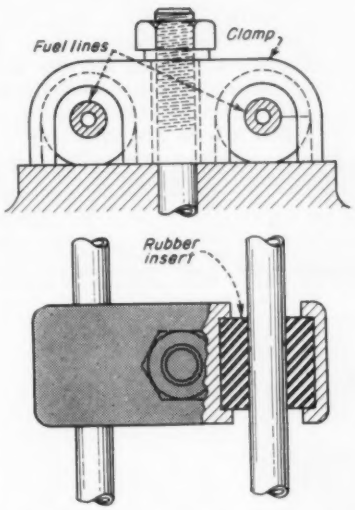
ANDREW GRIER *Staten Island, N.Y.*

INFERIOR MATERIALS may have minute holes that permit oil leakage. If leaks occur at the connections, there are probably small cracks in the brazing caused by faulty techniques in making the joint. Leaks followed by breakage are caused by cracks.

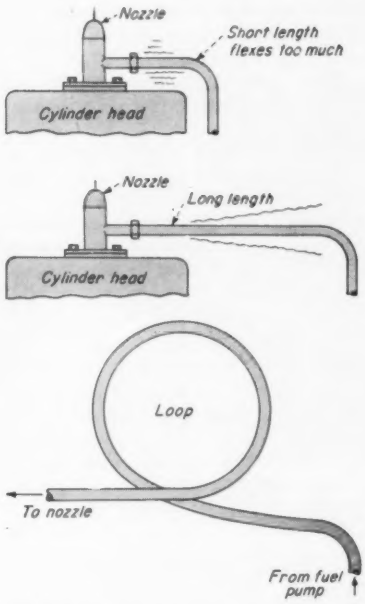
Transverse breaks may result from crystallization of the metal caused by too rapid cooling during brazing, or by mechanical vibration. Excessive engine vibration can be caused by wrong timing. Overly long fuel lines that are not correctly supported will vibrate excessively.

Putting a loop in the fuel line won't correct failures because it increases the distance the fuel must travel between the pump and the nozzle. This can cause late injection.

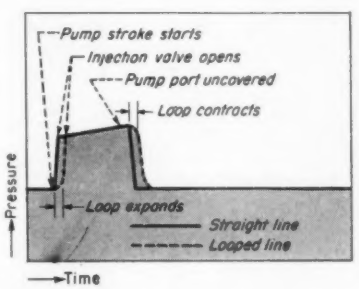
First step in curing *JL's* trouble is a complete check of the timing of each



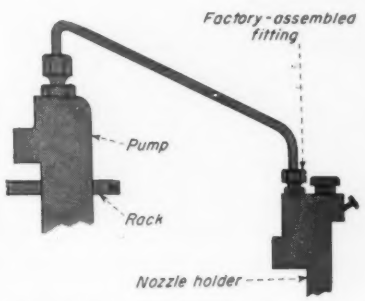
SPARKS uses a purchased rubber insert



COCHRANE recommends reducing flexes



HOLCOMBE says loops may change timing



ARDALINO runs readymade tube as shown

Begins on page 138

cylinder. If timing is satisfactory, fit clamps to rigidly support long fuel lines. When this will not cure the trouble, tubing with a thicker wall and smaller bore may be needed.

Give particular attention to pump height, shimming or removing shims if small changes are necessary. See that plunger-to-delivery-valve clearance is correct. Check the position of the pump racks and cams if these are individually adjustable. Wear in the linkage between the rack and the governor control shaft may also cause uneven running and too much vibration.

A M Damerow *Elk River, Minn.*

SAME BREAKS occurred in our three 1440-hp diesels. When they started, we thought the lines had been drawn up too tight. We replaced the broken lines with new ones 1 in. longer than the old. But the breaks continued. We tried looping the lines; still no luck.

We finally decided that engine vibration was the culprit. Automotive truck-type fuel lines seemed to hold the answer for us. So we purchased a set for each engine. That was three years ago and they are still in perfect condition.

We've found another use for truck-type fuel lines. Installed on the water-cooled bearing caps of our feed pumps, they last indefinitely. They are much easier to remove than standard ¼-in. pipe fittings.

L W Fitzpatrick
Jefferson City, Mo.

BEST MATERIAL for fuel lines subjected to high pressures is SAE 1010 steel that has less than 0.1% carbon, and a maximum tensile strength of 45,000 psi. A pigtail loop in the line helps absorb vibration and may reduce internal strain. Use the same length of fuel line for each cylinder. This insures identical hydraulic characteristics.

James Smithwick
Washington, D. C.

LOOPS IN LINE may reduce the effects of vibration, the most obvious cause of this trouble. Check pressure at nozzle inlet to see that loop does not cause an excessive drop. Changes in direction of line run will also help alleviate the vibration.

Using a tube material with a greater endurance limit may lengthen fuel-line life. Consult a tubing manufacturer for advice.

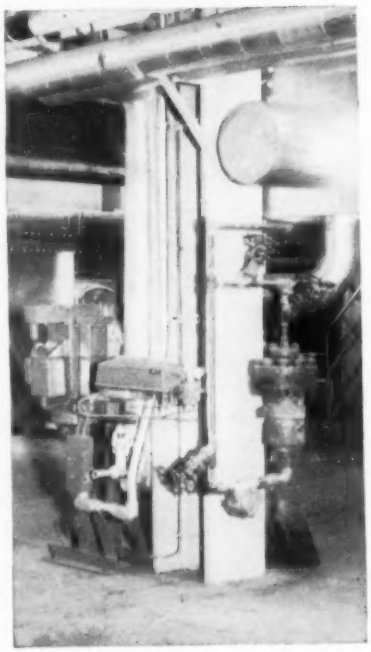
H B Wayne *Brooklyn, N.Y.*
A J Breugelmans *New York, N.Y.*

Should We Trap Superheated Steam Lines?

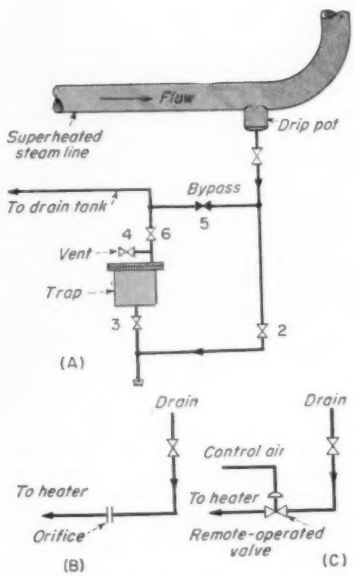
HERE ARE THE FACTS: This is a problem we run into every time we install new piping. Some engineers favor an orifice for condensate removal—others use traps and obtain excellent results. And I've heard of plants that use only manual drain valves, which are opened during line warm-up. Once the line reaches operating temperature and all condensate is removed, the valves are shut.

Which is the best device for removing condensate from lines carrying superheated steam? How is it best hooked up?—*BZ, Jan Power*

Here Are the Answers



KELLAND gets good results with traps



BREUGELMANS recommends these ways

PHOTO SHOWS high-pressure trap in our plant. These units prove far more economical and dependable than orifices or manually operated drain valves.

Don Kelland *New York, N. Y.*

SUPERHEATED steam lines can be freed of condensate in several ways. Most direct method uses manually operated drain valves that an operator opens during start-ups. These are allowed to blow free until normal running conditions are obtained. Catch here is that an operator must be on hand to open and close the drains at the right moment.

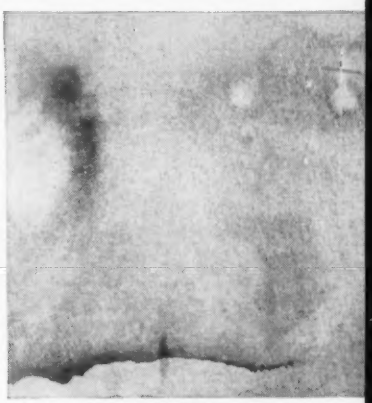
Trapping condensate gives automatic control. Sketch *A* shows one typical piping arrangement for a trap. Valves 1, 2, 3 and 6 are normally open. They

(*Continued on page* 142)

HOW NEW SOLNUS OILS HELP MAKE AIR COMPRESSORS FIRE SAFE

Actual photographs show amounts of carbon residue left after dropping equal quantities of Solnus and two other oils on steel plates and baking in a closed oven at 500°F for 24 hours. The three oils all had viscosities of 300 SUS at 100°F.

SEE HOW CLEAN SOLNUS LEAVES HOT METAL



New SOLNUS Oil 0.9%

Typical Naphthenic Oil 5.5%

Typical Paraffinic Oil 9.0%

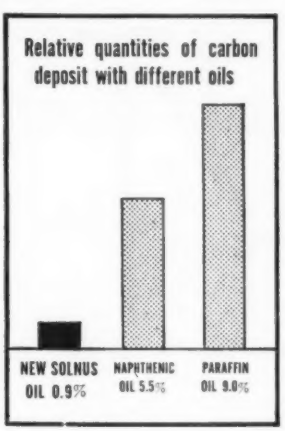
The biggest cause of air compressor fires or explosions is carbon formation on valves and in discharge lines. The best way to avoid these risks is to use the lubricating oil having the lowest tendency to form carbon.

New Solnus Oils have been proved ideal for air compressor use. The minute amounts of carbon that will form are of a fluffy nature; so they blow off quickly and do not build up. Thus the danger of fire or explosion is largely removed.

Solnus Oils have other important advantages, too. Your compressors need cleaning less frequently. This reduces maintenance costs. Shutdowns are less likely. Plant efficiency is increased.

Solnus Oils are also ideal for circulating systems, hydraulic systems, gear boxes, and general lubrication of your industrial equipment. They simplify your storage problems by doing with *one oil* many jobs that would otherwise require *several*. Combine their ability to protect metal parts against corrosion, their resistance to oxidation, and their moderate price and you see how Solnus Oils give you "more lubrication per dollar."

Let us send you our complete technical bulletin on Solnus Oils. Just write Dept. P-4.



INDUSTRIAL PRODUCTS DEPARTMENT

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Refiners of the famous Blue Sunoco and Dynalube Motor Oils

More PLANT PROBLEMS

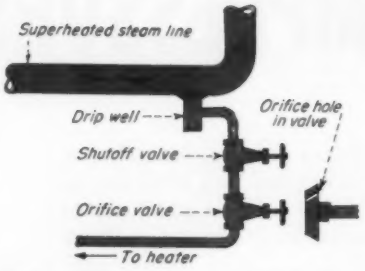
Begins on page 138

are closed when there is steam flow through the header and the trap needs maintenance. Valve 5 is opened while the trap is undergoing overhaul or repairs. With this hookup all you need do is make a routine check of the trap to see that it is working right.

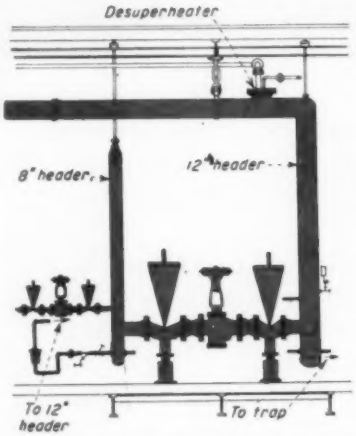
An orifice may be installed beyond a manually operated valve, as in sketch *B*. Valve is left open at all times except during repair or replacement of orifice. Discharge is piped to a heater or other unit operating at lower pressure.

Third method has a diaphragm- or motor-operated valve actuated by a push-button, as in sketch *C*. Valve can be opened during start-ups or at any other time when condensate drainage is necessary. Be sure valve is the type that opens automatically if air pressure fails.

A J Breugelmans *New York, N.Y.*



MOULTON'S riser-heel trapping methods



ROPER traps big headers at the heels

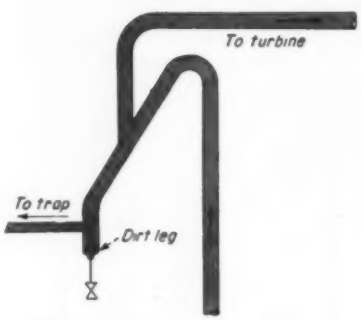
PLAY SAFE. Trap all steam lines. But capacity of trapping facilities should be selected only after considering length and size of pipe, insulation used, steam pressure and temperature, line operating conditions, and temperature of surrounding air. All these factors influence the amount of condensate formed.

Trap riser heels, dead ends of pipes, vertical loops and other low points. Impulse traps are excellent for indoor and outdoor jobs when piped with a strainer and bypass, and installed according to the manufacturer's instructions.

Orifices can be used but they are difficult to proportion for all conditions of service in the plant. They are best where the discharge can be used in a heater or some other vessel operating at a lower pressure.

Sketch shows a hookup used to drain a riser heel. Orifice valve can be made by drilling a hole of suitable size in the disk, as shown. Shutoff valve is opened during warm-up and at other times when condensate must be drained from the line.

A H Moulton *Pittsfield, Mass.*



BELTON'S special hookup for a turbine

CONDENSATE does not collect in superheated steam lines during normal operation; the only time it is present is during warm-up and on certain other rare occasions. So it is easy to see why *BZ* is tempted to do without traps. However, there are objections to almost every other scheme. The importance of these depend on the application.

Manually operated drains are objectionable because during an emergency an operator must be on hand to drain accumulated condensate from the header or pipe. An orifice wastes steam to the atmosphere, unless its discharge is used in a heater or some other device.

Even with a strainer to protect an

(*Continued on page 218*)

YOUR NEW PROBLEMS FOR APRIL

1 What's Best Scheme To Replace Lamps?

We have over 7000 fluorescent lamps for office and production-area lighting in our large industrial plant. We now replace burned-out lamps on what I term a hit-or-miss basis.

The foreman calls our electrical maintenance shop if a lamp burns out in a department, and it is replaced as soon as possible. This may be the next day or a month later, depending on how much work the electrical crew has.

During replacement, production may be slowed down or stopped completely. If another lamp has burned out, the electrician must go back to his shop for a second replacement. The whole procedure appears wasteful and expensive.

How do *Power* readers replace lamps? Does group replacement pay off? How are the intervals figured? How are large numbers of lamps best transported?—*VC*

2 How Can We Keep Static Off Belts?

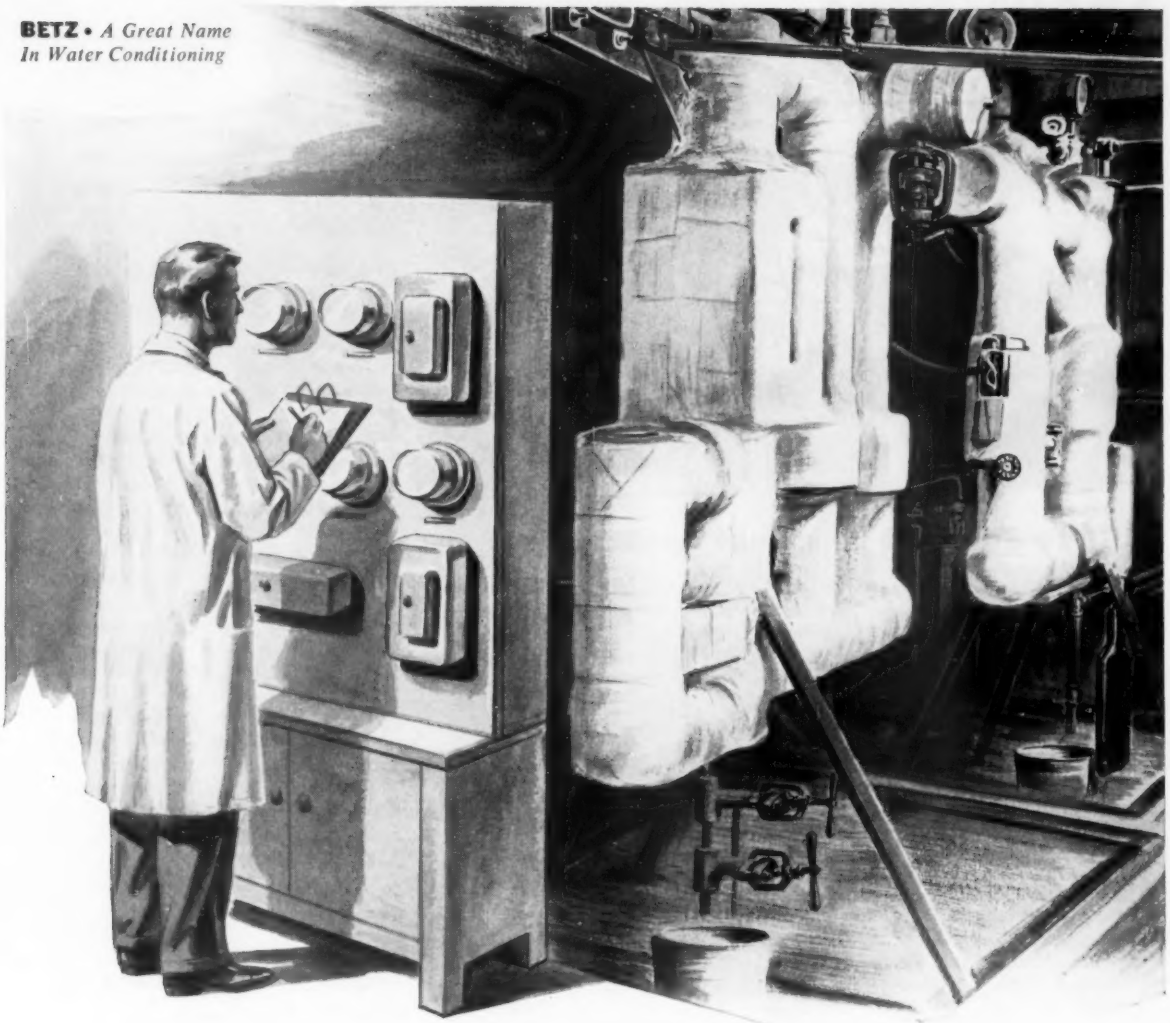
We plan to belt-drive three centrifugal pumps for handling gasoline. Existing conditions prevent us from trying chains and other types of drives, so we must use belts. The problem of static electrical charges has me worried because the explosive hazard may prove too great.

How can we rid the belts of charges while they are operating? According to our present plans we can use either V or flat belts, depending on type of pulleys we select for the job.

Direct drive is not feasible for any of the pumps, though it appears to be the simplest solution. Are there any commercial devices for eliminating the charge on belts? How are they applied? How effective is this solution in ridding us of the danger of igniting the gasoline vapors?—*TA*

Will you help readers who sent problems? Extra pay for photos, sketches.

BETZ • *A Great Name In Water Conditioning*



Proving ground for an idea

Many of today's industry-accepted water conditioning techniques were unknown just a few short years ago. Yet they were made possible by the extensive research which is carried on daily at our headquarter laboratories in Philadelphia.

Little wonder then, that we consider our *continuing* program of research and development so important.

The testing and retesting of new chemical compounds and formulations—*under actual plant conditions* in complex "Tom Thumb" equipment like this—is only a small part of our research program conducted to assure better water conditioning for industry.

As a result, advanced Betz discoveries, tested in the laboratory and *job-proved* in the field, have vastly increased operating efficiency and economy in industrial plants, petroleum installations, and institutions—everywhere.

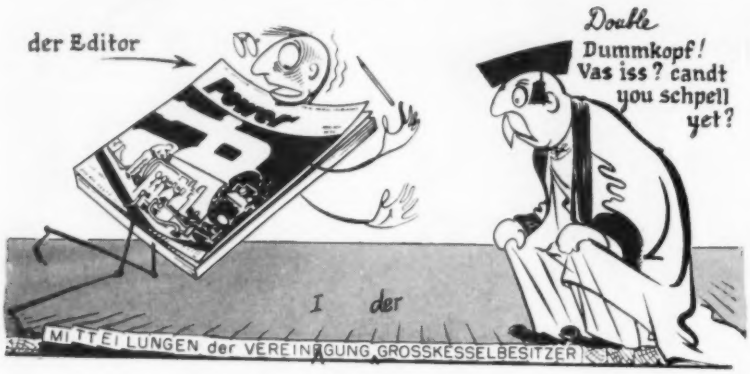
W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: BETZ Laboratories Limited, Montreal 1.

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

ARGUMENTS

Here's the place to unload your gripes and express your ideas. Shoot in a letter on your favorite subject



Vee Still Dunt Spik Goot German Here

PAGE 142 of January POWER has another example of the saying, "Daitsche Sprak, schwere Sprak."

In your nice cartoon there is another spelling error. It should read "Vereinigung," not "Vereinegung." Vereinigung had been correctly spelled by Mr Fernes in Baltimore. But still the title is not correct.

You have omitted the article "der." As you can see from the attached clipping, it is actually "Mitteilungen der Vereinigung der Grosskessel-Besitzer."

G KEINATH *Larchmont, N. Y.*

EDITOR'S NOTE: *At last this German title is straightened out. At least, we* HOPE *it is. Many thanks to Reader Keinath for setting us right.*

Outlines Limits for Defects in Welds

IN JANUARY *Arguments*, E Y K wants to know about the maximum permissible defects in welds for 12-in. steam piping operating at 1250 psig, 950 F.

Here's what I suggest:

Section 1, paragraph P-109 b of *ASME Boiler Construction Code* states: "Pinholes, cracks or other defects may be repaired by chipping, machining or burning out the defect and rewelding."

Section 9, Welding Qualifications—Defects, in the same code comments: "Any cracks or blow holes that appear on the surface of any layer of welding shall be removed by chipping, grinding or gas gouging before depositing the next successive bead of welding."

Both these comments apply to boiler parts like drums, tubes, etc.

The code is not explicit in stating the maximum permissible defects for welded piping, but interpretation of the above paragraphs indicates that no weld defect should be tolerated, especially at the pressure and temperature given.

The expression "A chain is as strong as its weakest link," applies here. E Y K should also check the state boiler and piping codes, local ordinances and insurance underwriters requirements.

H B WAYNE *Brooklyn, N. Y.*

Beware of Too Much Grouting Space

ON PAGE 131, January POWER, "Roughened Foundation Surface Anchors Grout," states incorrectly that you need about 4 in. of grout space under heavy machinery.

The correct information is that too much space under an engine is dangerous. You need special nonshrink grout when space is more than 1½ in. Manufacturer recommends only 1 in. Where space is as much as 3 in. add ¼ to ⅜ in. pea gravel to grouting mixture.

FRED CARTER *Buffalo, N. Y.*

EDITOR'S NOTE: *Reader Carter is right. We received the photo without text and gave you readers the wrong slant. By all means go by the above.*

Wants Boiler-Fuel Advice

CAN ANY READER tell me what type boiler and grate-bar arrangement is most adaptable to coconut-shell fuel? This fuel is peculiarly detrimental to boilers, especially high-pressure units. I should like to compare other engineers' opinions with my own.

L B VILLARTA *Oroquieta, Philippine Islands*

Handle Radioactive Materials With Caution

THE RADIOACTIVE METHOD of finding a plugged boiler tube, described on page 132, January POWER, may involve serious hazards.

Any material whose radiations can penetrate a steel tube is extremely dangerous to persons coming into prolonged contact with it, even though quantities are minute.

Special training in rigid safety precautions is necessary. The radioactive material must not come into contact with the skin, be spilled on clothing, work table or floor, or used in any way that permits even the smallest quantities of it to enter the body, remain on the skin, or provide a source of contamination for others. Rubber gloves and long-handled forceps help avoid contact.

The dangers of improper use are particularly insidious because you have no warning of exposure by taste, smell or feeling. In one way, radioactivity is similar to high-voltage electricity—people who know exactly what they are doing can handle it with complete safety. But it is extremely dangerous in the hands of untrained persons.

H H POOR *New Canaan, Conn.*

Would Use Noncollege Men as Engineers

REGARDING GEORGE EDWARDS' question about the shortage of engineers (July, p 168), I believe every company has a few men who did not get a college education, but who are otherwise qualified to fill engineers' positions. These men should be called upon. They have been working three, four or five years in their particular industry and would be well ahead of college graduates who are just starting out.

The noncollege men's technical knowledge, not of mechanical engineering in general, but of the particular industry, should be built up as rapidly as possible.

With careful selection every industry could build up its engineering force more solidly by using some of these men than by requiring all engineers to have college degrees. Further, I believe the practical man on the way up will enjoy using his new knowledge so thoroughly he will not think about a job in the sales end of the business.

D L COCHRANE *Milaca, Minn.*

here is the means for
Fast, Trouble-free Condensate Drainage
THE ARMSTRONG HIGH CAPACITY DRAINAGE TRAPS
Big air vent for fast heat-up
Hardened chrome steel valve and seat—for long, long life
A size for every job.
Condensate and air enter above water level—preventing wear-producing agitation
BIG CAPACITY
Bucket and lever assembly are stainless steel to fight wear and corrosion
Add it up!
1. All the capacity you need
2. Fast air venting
3. Low Maintenance
Mail the coupon now!
Unconditional GUARANTEE
Satisfies you or your money back
ARMSTRONG
INVERTED BUCKET STEAM TRAPS
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312 Maple Street, Three Rivers, Michigan
Send data on High Capacity Traps.
Send 44-page Steam Trap Book.
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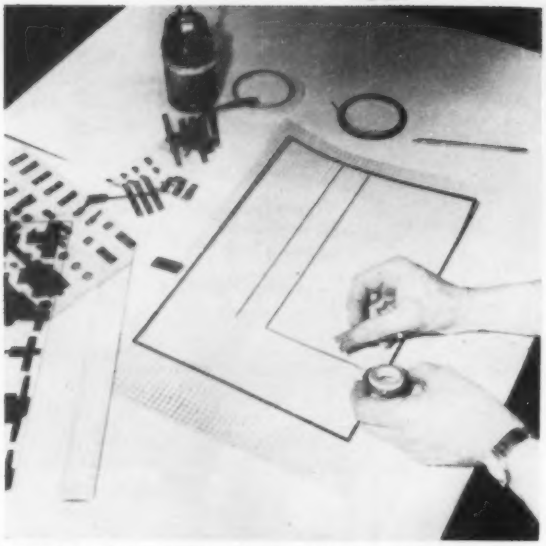
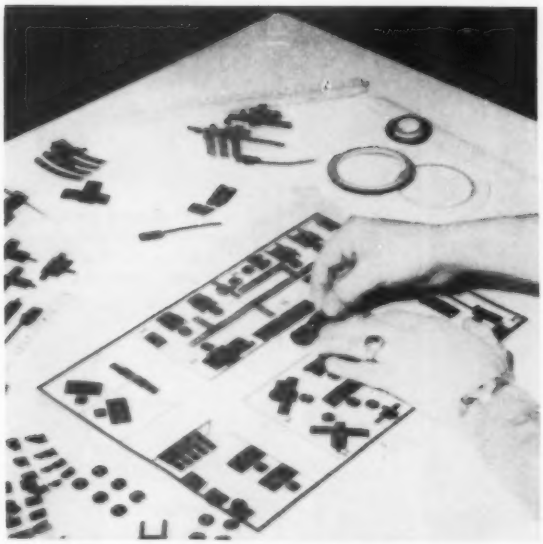
Company
Street Address
City
State

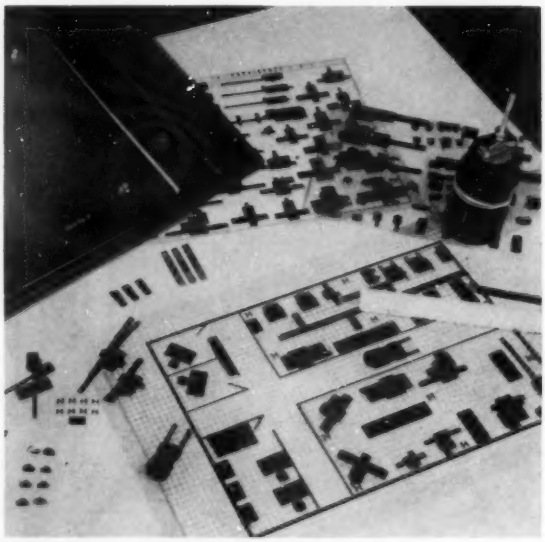


TAPE outlines plant areas, offices, etc...

GLUE is applied to back of template...



PRESS the template firmly on layout film...



FLEXIBLE layout is ready for printing

HOW TO

Use Templates for Plant Layouts

Courtesy Repro-Templets Inc. Oakmont, Pa.

► THE LAYOUTS shown here are made on acetate-film grid sheets to a scale of ¼ in. = 1 ft. First step in preparing a layout is to outline the plant building or department with ⅛- or 1/16-in. colored layout tape.

Then the building area is subdivided into the proper departments, offices, etc, with the colored tape. Columns, center lines, doors and other elements of the building influencing layout are also shown on the grid sheet.

Templates of the machines proposed for the given area are next glued to grid sheet. These show actual floor area and operating space needed for each machine. With all equipment in place, layout is ready for printing. It can be run through any blueprint, ozalid or photostat machine to produce as many prints as needed for the job.

Repro-Templets are available in a master file of 5000 ¼-in. scale templates of the most-used machine tools and shop equipment built by some 160 manufacturers. Layout film is 12x18 in. Maker will supply data on the types of templates available for use in your plant.

STEAM...is only as good as you use it!

Use steam the right way to reduce production costs, improve product quality and output—

When production slow-downs, high costs, and poor product quality occur, don't always blame the process equipment – often the fault is in *the way steam is used.*

For example, waterlogging caused by improper trapping or poor steam circulation, seriously affects heat transfer, reduces output, and creates production bottlenecks. Improper air venting does the same. Poor temperature control can lower product quality, cause rejects and further raise production costs.

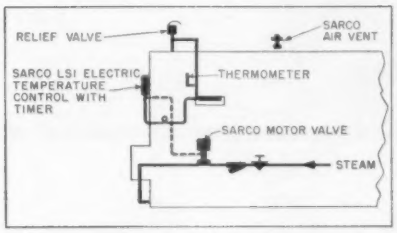
If your plant is suffering from any of these production handicaps, Sarco can help you.

Plant after plant has benefited from Sarco's experience in the process industries. The complete line of Sarco steam traps and temperature controls enables Sarco engineers to offer impartial, expert recommendations on how to make steam work best in your plant.

Why not call on Sarco for engineering recommendations next time you need help. For case histories describing how other plants in your field solved similar problems, write today to Sarco Company, Inc., Empire State Building, New York 1, N.Y.

SARCO

improves product quality and output



Combination temperature controller and air vent hook-up

How to achieve accurate, low-cost sterilizer temperature control

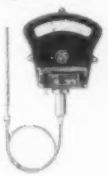
The Chocolate Products Company, Chicago, makers of KAYO, famous chocolate milk drink, now gets accurate, low-cost temperature control in its Fort Wayne Sterilizer.

PROBLEM: Manual temperature control of sterilizer caused excessive product spoilage and waste of man hours to check and adjust temperatures.

SOLUTION: The time-temperature control hook-up above. High capacity air vent eliminates air-steam mixtures which are often 20° F below steam temperature; permits sterilizer to fill quickly with pure steam. When proper temperature is reached, controller actuates timer and temperature is maintained for required length of time.

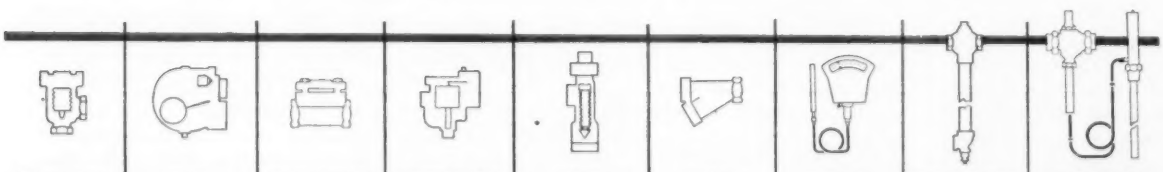
RESULTS: Required temperatures held to within plus or minus one degree. Time needed for effective sterilization reduced.

Many bottling and canning plants are turning to this inexpensive Sarco hook-up for more efficient sterilizing. Write for details and a complete hook-up sketch.



Sarco Electric Temperature Controller is accurate and inexpensive. Holds temperatures to ±1° F. Setting easily changed by turning one knob. Ask for Bulletin 1025.

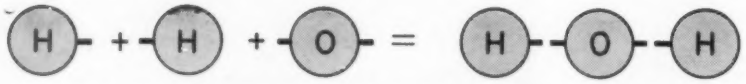
STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS



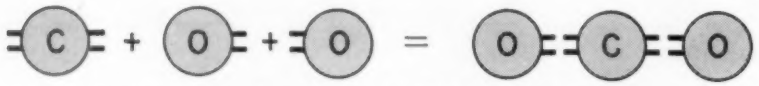
Thermostatic Steam Traps | Float-Thermostatic Steam Traps | Thermodynamic Steam Traps | Camlift Bucket Steam Traps | Liquid Expansion Steam Traps | Strainers | Electric Temperature Controllers | Water Blenders | Self-Operated Temperature Controllers

HEADWORK

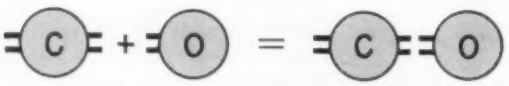
PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH



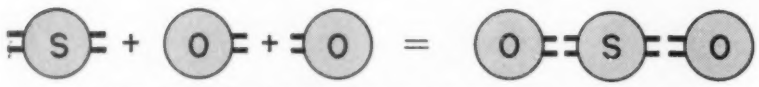
Two atoms of hydrogen combine with one atom of oxygen to produce one molecule of water (H_2O)



One atom of carbon combines with two atoms of oxygen to produce one molecule of carbon dioxide (CO_2)



One atom of carbon combines with one atom of oxygen to produce one molecule of carbon monoxide (CO)



One atom of sulfur combines with two atoms of oxygen to produce one molecule of sulfur dioxide (SO_2)

Burning Hydrogen

H_2	+	O	$= H_2O$
2	+	16	= 18
1 lb	+	8 lb	= 9 lb

Burning Carbon to CO

C	+	O	= CO
12	+	16	= 28
1 lb	+	16/12 lb	= 28/12 lb

Burning Carbon to CO_2

C	+	2O	$= CO_2$
12	+	32	= 44
1 lb	+	32/12 lb	= 44/12 lb

Burning Sulfur

S	+	2O	$= SO_2$
32	+	32	= 64
1 lb	+	1 lb	= 2 lb

Combustion Facts-2: HOW ATOMS COMBINE

► LAST MONTH we saw that every atom has its heavy core or nucleus made up of protons and neutrons. More than 99.9% of the weight of any atom is concentrated in its nucleus.

For practical purposes the "atomic weight" is merely the number of particles in this nucleus. For example, the nucleus of the carbon atom contains 12 particles (6 neutrons, plus 6 protons), so the atomic weight of carbon is 12.

Aside from its weight, the nucleus takes no direct part in ordinary chemical reactions, including the reactions of combustion. The electron planets revolving around the nucleus determine the chemical characteristics of the substance—how one atom will combine with others in various chemical compounds.

There is one of these electron planets for every proton in the nucleus. For example, carbon has 6 protons in the nucleus and 6 electron planets, all circling around without rest at terrific rpm.

From now on, as far as practical combustion chemistry is concerned, we can forget all about the protons, the neutrons, the nucleus, and even the electrons. Instead, we can think of the atom as a solid pellet with projecting hooks by which it can be attached to other atoms.

We shall be concerned with the chemical reactions of the elements listed in this table.

Element	*Symbol*	*Atomic wt*	*"Hooks"*
Carbon	*C*	12	4
Hydrogen	*H*	1	1
Sulfur	*S*	32	4
Oxygen	*O*	16	2

Of the above the first three are combustible elements. They are said to "burn" when they combine rapidly with oxygen and give off heat in the process.

The sketches at the top of the page show how the imaginary "hooks" engage when any of the three combustibles combines with oxygen to form a molecule of the combustion product. If combustion is complete, all the hooks are paired.

In the first line you can see that it takes two hydrogen atoms, each with its single hook, to match one oxygen atom with two hooks. In the second reaction it takes two oxygen atoms, with two hooks each, to match one carbon atom with four hooks.

The third reaction shows how one atom of carbon burns incompletely with one of oxygen in incomplete combustion to produce one molecule of carbon monoxide. In this case the combustion product has two carbon hooks still free to pick up another atom of oxygen. That's why carbon monoxide can be burned with additional oxygen to produce carbon dioxide.

Equations, *at left*, show conventional ways of expressing combustion reactions. Take the case of carbon completely burned to carbon dioxide. The

(*Continued on page* 224)

JENKINS PRACTICAL PIPING LAYOUTS 72

Diagram by Huxley Madeheim, Consulting Engineer
Copyright, 1954 — Jenkins Bros.

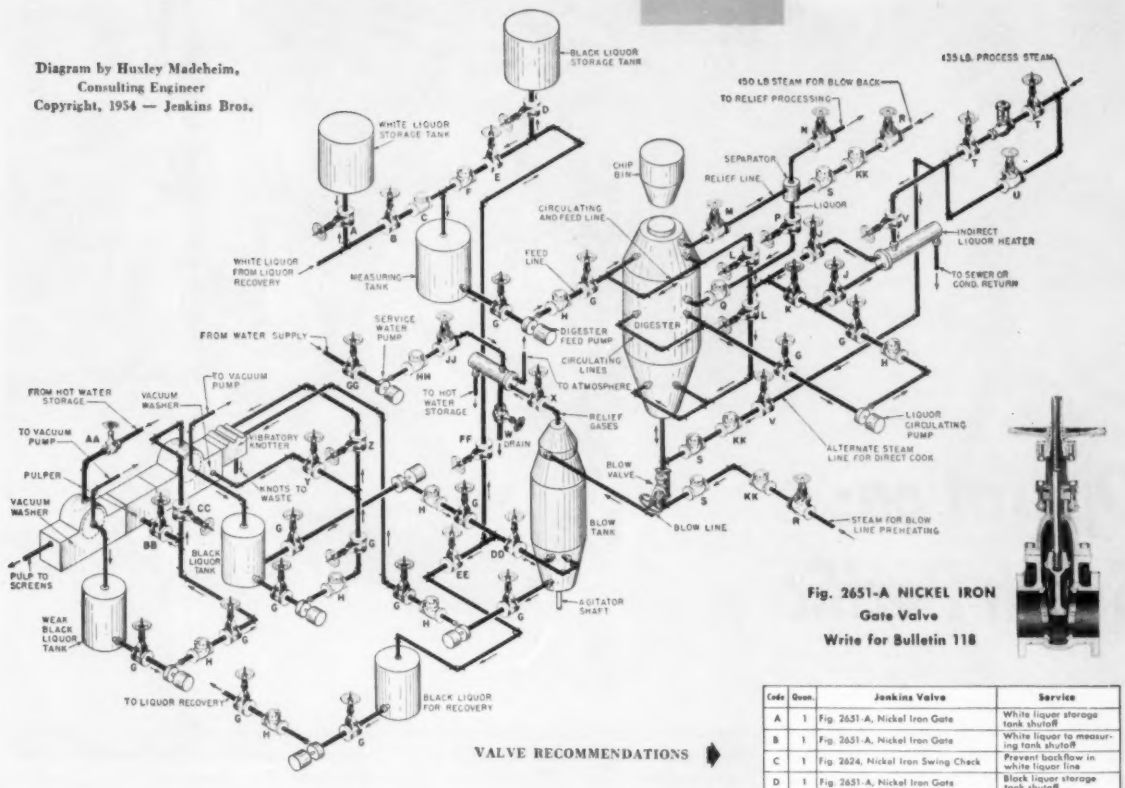


Fig. 2651-A NICKEL IRON Gate Valve
Write for Bulletin 118

VALVE RECOMMENDATIONS

Code	Quan.	Jenkins Valve	Service
A	1	Fig. 2651-A, Nickel Iron Gate	White liquor storage tank shutoff
B	1	Fig. 2651-A, Nickel Iron Gate	White liquor to measuring tank shutoff
C	1	Fig. 2624, Nickel Iron Swing Check	Prevent backflow in white liquor line
D	1	Fig. 2651-A, Nickel Iron Gate	Black liquor storage tank shutoff
E	1	Fig. 2651-A, Nickel Iron Gate	Shutoff black liquor to measuring tank
F	1	Fig. 2624, Nickel Iron Swing Check	Prevent backflow in black liquor line
G	14	Fig. 2651-A, Nickel Iron Gate	Liquor Pump shutoff
H	7	Fig. 2624, Nickel Iron Swing Check	Prevent backflow through pump
J	2	Fig. 2651-A, Nickel Iron Gate	Liquor heater shutoff
K	1	Fig. 2651-A, Nickel Iron Gate	Liquor heater bypass
L	2	Fig. 2651-A, Nickel Iron Gate	Liquor circulating line shutoff
M	1	Fig. 1317, Stainless Steel Globe	Digester relief control
N	1	Fig. 1317-A, Stainless Steel Globe	Control flow of relief gas
P	1	Fig. 2651-A, Nickel Iron Gate	Shutoff liquor from separator
Q	1	Fig. 1331, Stainless Steel Swing Check	Prevent backflow to separator
R	2	Fig. 1040, Cast Steel Globe	Control steam flow
S	3	Fig. 1331, Stainless Steel Swing Check	Prevent liquor flow to steam line
T	2	Fig. 1009, Cast Steel Gate	Control valve shutoff
U	1	Fig. 1040, Cast Steel Globe	Control bypass steam
V	2	Fig. 1009, Cast Steel Gate	Steam shutoff
W	1	Fig. 106-A, Bronze Globe	Drain line control
X	1	Fig. 1307-A, Stainless Steel Gate	Blow tank vent shutoff
Y	1	Fig. 2651-A, Nickel Iron Gate	Black liquor shutoff to washer pan
Z	1	Fig. 2651-A, Nickel Iron Gate	Black liquor shutoff to knotter
AA	1	Fig. 106-A, Bronze Globe	Control water to wash spray
BB	1	Fig. 2651-A, Nickel Iron Gate	Black liquor shutoff to pulper
CC	1	Fig. 2651-A, Nickel Iron Gate	Black liquor shutoff to wash spray
DD	1	Fig. 2651-A, Nickel Iron Gate	Black liquor shutoff to blow tank
EE	1	Fig. 2651-A, Nickel Iron Gate	Black liquor shutoff to recovery
FF	1	Fig. 2651-A, Nickel Iron Gate	Black liquor shutoff to storage
GG	1	Fig. 651-A, I.B.B.M. Gate	Service water pump shutoff
HH	1	Fig. 624, I.B.B.M. Swing Check	Prevent backflow through pump
JJ	1	Fig. 613, I.B.B.M. Globe	Control water supply
KK	3	Fig. 1025, Cast Steel Swing Check	Steam line check

How to plan a SULPHATE PULPING PROCESS SYSTEM

Chemical treatment begins when chips, conveyed to the digester, are cooked in an alkaline solution of sodium sulphide and caustic soda. The residual spent solution (black liquor) is used in subsequent processing, or is restored to its original state in a chemical recovery cycle. The resultant economy is an important advantage of the sulphate process.

The digester fluid is prepared by combining the alkaline solution, either new or recovered (white liquor), with black liquor from the digester discharge, in a predetermined ratio. This blended liquor is pumped into the digester simultaneously with the chips. A liquor circulating pump thoroughly agitates the mixture, and liquor drawn from the center of the digester bypasses the indirect liquor heater and is returned to the bottom of the digester. When the charge is completed, the digester is closed, and the cooking begins.

An indirect heater is used for cooking in sulphate pulping, generally, to prevent excessive dilution of the liquor. This layout also shows an alternate steam line for direct cooking.

When the cooked mixture is ready for removal, the blow valve is opened and the charge is transferred to the blow tank where it is washed and cooled.

In a series of vacuum washers, the pulp is forced onto revolving drums. As the drum revolves, the pulp is washed by sprays. From the last washer, it goes to the paper making process.

Black liquor collected from the first washer is stored for re-use in the digester, pumped to the blow tank for washing the pulp, or pumped to the recovery cycle for conversion to white liquor. This recovery process will be described in a later Jenkins Layout.

Jenkins Nickel Iron Gates and Checks with Stainless Steel Trim are recommended in this system, for valves in contact with black or white liquor.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To simplify planning, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17. Sold through leading Industrial Distributors everywhere.

Complete description and enlarged diagram of this layout free on request. Includes additional detailed information. Ask for Piping Layout No. 72.

JENKINS VALVES
LOOK FOR THE DIAMOND MARK
SINCE 1864 JENKINS
Jenkins Bros

"Slow down!" roared the commander. "Unless we keep this speed for the next fourteen hours, we'll miss that rendezvous . . ."

Operation: South Pacific

► WITH EACH MAIL bringing more and more orders for autographed copies of POWER's latest one dollar venture, *The Marmaduke Story*, executive editor Lou Rowley asked me to bring Marmy up to our office "dead or alive." (But who'd be dead? Me? Certainly not Marmy).

"I don't care how you do it, but get him," said Lou, "and I'll have him put his John Henry on all these books." He gazed at the stack of bright red books with Marmy's kisser plastered all over the cover and added ruefully, "I only hope he can write."

The old consulting engineer's office above O'Houlihan's Machine Shop & Engine Works was locked. Next I tried his favorite haunt, that mariner's emporium of liquid refreshment, The Bent Propeller Bar. Marmy wasn't there either, but I got a hot tip that the old boy was coming clean. So I headed for a well-known one-story building on 41st St between 8th and 9th Avenues. The weatherbeaten carved sign above the door read, *Free Public Baths of the City of New York—Established 1902.* As I entered the door marked MEN, a tough looking character eyed me carefully then handed me two towels and a bar of soap.

"No thanks," I said, a little annoyed. "I'm looking for Mr Marmaduke Surfaceblow." Before I could say more, the deep rich strains of *Asleep in the Deep* blasted out from the showers and hit me like the broadside from a battleship. That foghorn voice vibrated the old building right down to its foundation. Before long, Marmy appeared looking like a refitted schooner fresh out of shipyard. After dropping a few hints about free lunch with side refreshments thrown in, I had no trouble getting him up to our office.

To make a long story short, Marmy finally did get busy scribbling his name inside those books. But all of a sudden he threw down his pen in exasperation and roared, "Bilgewater on paper work! Let me tell you guys about the time I helped sink a Japanese fleet." We all stopped work and listened. Marmy hoisted his canal boats up on the desk, gave his old gray bowler a port list, got his induced draft up on the cigar butt clenched in his teeth and blasted away.

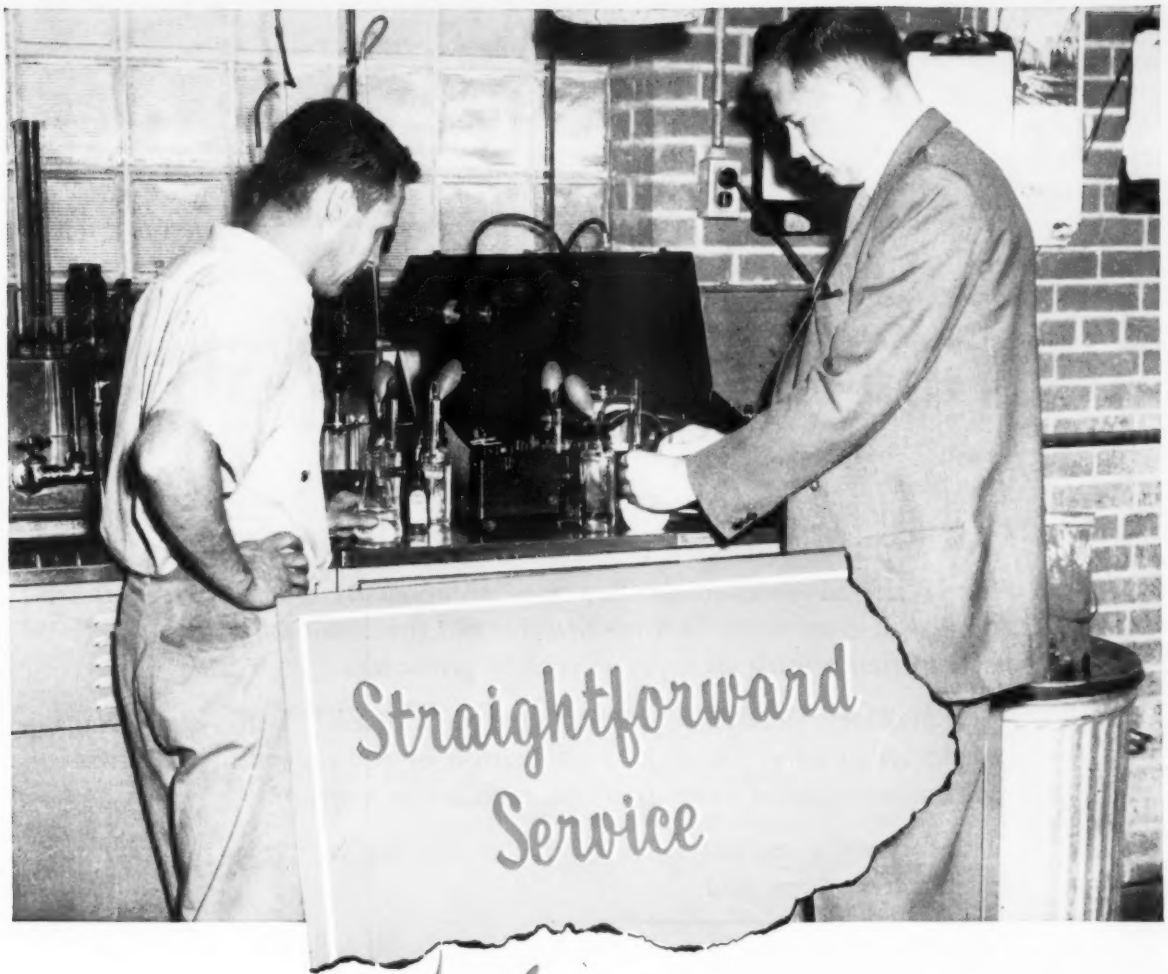
"During World War II, I was master mechanic at the submarine base at Pearl Harbor. Our pig-boats were giving the Japs hell just then, so we were working round the clock to keep the pack operating. One evening the commanding officer had me fly out to an advance sub base in a PBY. A pig-boat had just come in damaged and I had to take charge of emergency repairs so she could get back to Pearl. But soon as she was ready to shove off, a second sub came in, so I stuck around and gave her a routine inspection. These navy-trained engineers are all right, but I was responsible for those pig-boats, and I wanted to check them—personally.

"This sub's engineering officer had just joined the ship a few days before. Fact is, he'd arrived with me on the PBY from Pearl. This lad was one of those wide-awake college youngsters—he'd been a sales engineer for some pump manufacturer. In those days, the Japs were pushing us off island after island, so there was plenty of confusion when this new kid took over. To add to it all, an LST dumped a load of long overdue stores and spare parts on the beach. And a PBY landed personnel and a batch of overdue mail, including important directives from COMSUBPAC.

"With all the confusion, the chief glanced quickly through the stack of papers and filed them away. One of those marked URGENT was instructions to replace the cooling-water pump impellers on the diesels. His crew was taking spare parts aboard and stowing them away. They threw the small impellers under the floor plates along with other small parts.

"These cooling-water pumps were driven directly from the engines' main crankshafts. Although instructions called for immediate replacement of these impellers, there were too many

(*Continued on page* 206)



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Nalco WATER TECHS

A paper on "A Laboratory Method for the Study of Steam Condensate Corrosion Inhibitors," presented at the 8th Annual Conference, National Association of Corrosion Engineers, has been reprinted by Nalco for distribution to men interested in this problem. Your copy will be sent free upon request.

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HAGAN

Automatic Control Systems

The many advances in the design of components and the arrangements of Hagan Automatic Control Systems are the result of thirty-five years of experience with all types of control problems.

The accuracy, dependability and versatility of each unit permit Hagan engineers to select the right combination of equipment for coordinated accomplishment of every function required of a system.

The following are just a few of the services for which successful applications have been made.

Automatic combustion control for boilers of any size or pressure, firing all types of fuels, singly or in multiple.

Boiler drum water level control, with automatic compensation available for boiler load or water density.

Draft or pressure control over a continuous range from fractions of an inch water column to 5000 psig.

Superheated steam temperature control.

Steam pressure and temperature control for all types of reducing and desuperheating stations.

Controls for air preheated temperatures.

Feedwater heater pressure or temperature controls.

Controls for parallel or sequential operation of fans, blowers or pumps.

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Ring Balance Instruments

When you buy Hagan Ring Balance Instruments, you choose the most versatile units available for the service involved. The following are some of the factors which make this a reality:

Interchangeable sensing elements for full scale differentials from 1″ to 560″ WC.

Full scale range of each element adjustable over 7 to 1 ratio.

Dead weight calibration check can be made without disconnecting the meter from the line.

Spring resistance system produces reliability at lower flow ranges.

Mercury level is not critical.

No stuffing boxes or pressure-tight bearings.

Ample operating power at all rates of flow.

The breadth of application of Hagan Ring Balance Meters is indicated by these successful installation types.

Recording, indicating and integrating flows of water and steam, or liquid and gaseous fuels.

Simultaneous records of two separate flows, measured in a single meter housing. Flows may be added or subtracted for accounting and distribution purposes.

Pressure and temperature compensated records of steam and gas flows.

Pneumatic or electric signal transmission available.

Density compensated recording of boiler drum water level.

Density compensated recording of gas or liquid flows.

Flow ratio control for liquids and gases.

Remote recording, indicating and integrating.

Our engineers will be glad to suggest the Automatic Control and Instrumentation best suited to your requirements.

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HAGAN BUILDING **PITTSBURGH 30, PENNSYLVANIA**

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automotive and Aeronautical Testing Facilities

Speaking of power

personal slants on doings of interest to power men—some significant, some just odd

Electrical cremation may replace the Indian tradition of burning the dead on open funeral pyres. Worried about the hygienic hazards of this ancient practice, municipal authorities of Calcutta recently ordered a 54-kw electrical incineration plant from Brown, Boveri of Switzerland.

Before actual cremation occurs, current is applied to resistance elements embedded in refractory material. After the body enters the incinerator, stored heat and fresh-air injection do an odorless, smokeless job.

Perfect pure-iron crystals have been achieved by GE scientists, reports Dr C G Suits, research director. Without atomic-scale irregularities that have marred crystals previously made, these minute "whiskers" of pure iron reveal for the first time strengths as high as theory predicts.

With their vastly greater strength and inherent resistance to rust, these crystals "provide," says Dr Suits, "a new and exciting dimension in metallurgy. . . . In time, applied science will find practical use for this form of metal."

Double-duty drinking water: Two hydro stations being built deep in the Catskill Mountains will wring kilowatt-hours from water on its way to thirsty New York.

The 25,000-kw Neversink Station of Central Hudson Gas & Electric Corp will start up as soon as water is available from Neversink Reservoir. When Pepacton Reservoir and the connecting tunnel are completed late in 1954, Rockland Light & Power Co's 18,000-kw Grahamsville Station will go on the line.

Thermoelectric metal comparator developed at General Motors Research Labs can sort metals differing only slightly in composition – by as little as 0.05% carbon content, for example. Operating on the thermocouple principle, the portable device has two probe tips, which form the hot and cold junctions when they touch the metal under test. With junction temperatures held constant, differences in composition of the metal parts being tested cause minute voltage changes. These are amplified to give a suitable reading. For sorting various materials, different sets of probe tips are used.

The comparator has also been used for spotting "chills" in castings and appears suitable for measuring thickness of metallic plating or paint films.

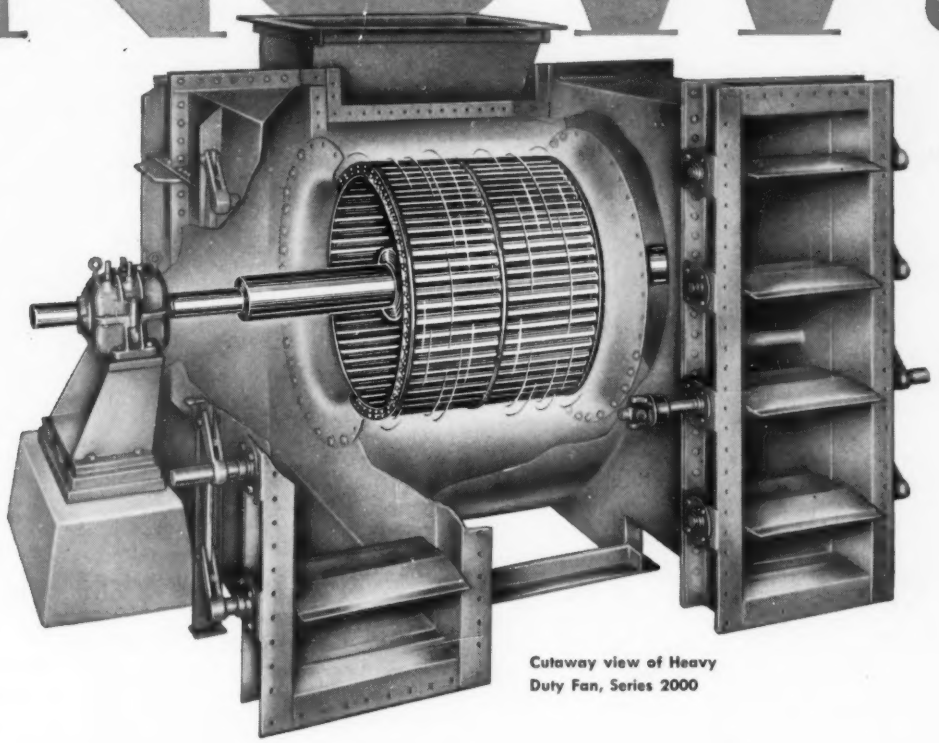
Railroad stories always seem particularly pithy. Witness this old but good one from Appalachian Coals' ACI Bulletin: The novice fireman lost his footing while the locomotive was taking on water, fell into the tank. Hearing his vigorous splashings, the veteran engineer spat, then remarked caustically, "Just fill it up, boy – you can't tamp it down."

Ion-exchange methods, familiar in water treatment, are attracting increased interest for concentrating metals from solutions and separating metal ions in mixtures. Permutit's A B Mindler cites successful treatment of brass-mill wastes, rare-earth separation processes and recovery of precious metals, such as platinum.

Experimental work looks toward concentrating dilute metal values in mine waters, leaching metallic ores, concentrating dilute metals from washings or process liquids. In the future, such hydrometallurgy should help to stretch strategic ore resources and make use of low-grade ores economical.

Lou Lowley

NOW!



Cutaway view of Heavy Duty Fan, Series 2000

a **more efficient** heavy duty fan with Forwardly Curved blading

Here is the *NEW* Heavy Duty Fan, with forwardly curved blading, designed specifically for induced draft service. This Series 2000 fan has wide application in steam plants of public utilities and industrial plants for both process steam and power generation. Sturtevant Division has long recognized and manufactured fans with forwardly curved blading . . . and as a result, designed into *this* fan the maximum air handling capacity and efficiency yet obtained in forwardly curved blading.

By comparison this Series 2000 Heavy Duty Fan has:

(a) lower first cost—smaller space requirement
(b) greater air output for less power input
(c) more efficient conversion of velocity energy

Air Handling power specialists located strategically across the country possess the know-how and engineering information to assist you in selecting this Series 2000 fan to your specific requirement. Contact your nearest Westinghouse-Sturtevant Office, or write to Westinghouse Electric Corporation, Sturtevant Div., Hyde Park, Boston 36, Mass.

Now just off the press is a new catalog describing the Heavy Duty Fan, Series 2000, in detail.

Fill in the attached coupon and send for your copy of Catalog 1380 today.

Westinghouse Electric Corporation
Sturtevant Division
Hyde Park, Boston 36, Mass.

Please send me your copy of Catalog 1380 describing in detail the new Heavy Duty Fan, Series 2000, with forwardly curved blading.

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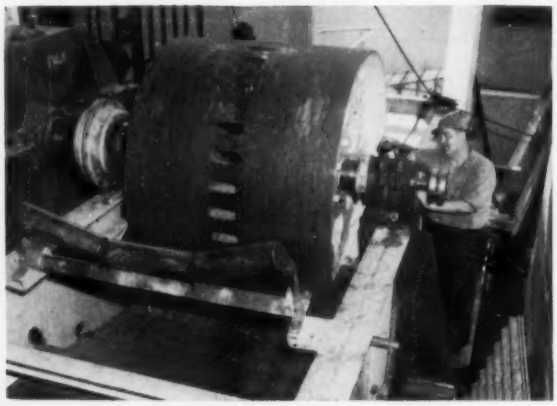
YOU CAN BE SURE... IF IT'S Westinghouse

J-80379

READER SERVICE SECTION

POWER NEWS_____156
TECHNICAL BRIEFS_____158
PLANT EQUIPMENT NEWS_____162
NEW FREE BULLETINS_____171

FRANCIS RUNNER, built by S Morgan Smith Co for Niagara Mohawk Power Corp, goes to first of five stations on Raquette River near Potsdam. Completed turbine will produce 25,400 hp at 120 rpm under 82.7-ft net head.



MAGNETIC PULLEY, believed to be world's largest, has 60-in. dia with 48-in. face. Built by Stearn's Magnetic, Inc, unit will magnetically remove tramp iron from coal used at Oak Creek Station of Wisconsin Electric Power Co.

Summer school trains industrial fire-fighters

► INDUSTRIAL FIRE-FIGHTERS will learn to solve the problems peculiar to their fields at a series of three-day schools to be held this summer at Marinette, Wis. Sponsored by Ansul Chemical Co, these classes will cover latest techniques for extinguishing all types of fires including specific industrial "problem" fires.

Students will include safety directors, fire marshals and plant fire-brigade leaders. Their "classroom" will be an 8-acre test field fully equipped to simulate every type of fire found in industry. Attendance is free; students pay only their living costs while in Marinette. Ansul will provide instructors, equipment and fire-extinguishing materials.

Last year, nine 3-day classes were held at Marinette and the reaction was so favorable that Ansul has scheduled 11 classes for 1954. Starting dates are May 24; June 14, 21, 28; July 19, 26; August 16, 23, 30; September 13, 20. Registrations will be limited to 25 persons for each school and will be accepted on a first-come-first-served basis.

Students will have the opportunity to use the latest mobile and stationary equipment against a large variety of fires, including flammable liquid and propane gas fires. In addition, there will be group discussions and fire-fighting films. Students will be invited to bring up any special problems peculiar to their particular industries.

APCA sets up individual awards

► THE FIRST AND ONLY AWARD to recognize an individual's contribution to air pollution control has been established by the Air Pollution Control Assn. This award will be presented at each annual meeting, starting with this year's meeting, May 3-6, at Chattanooga.

The award will be named The Frank A Chambers Award, in honor of this early advocate of the "engineering approach" to air pollution problems. Chambers was one of the first technical engineers to hold the position of head of a smoke control bureau. He served the city of Chicago in this capacity for over 40 years and was executive secretary of APCA from its early days, when it was known as the Smoke Prevention Assn, until his death in 1951.

Founded in 1907, APCA provides a common meeting ground for industrialists, control officials and other interested parties to resolve their mutual problems in this controversial field.

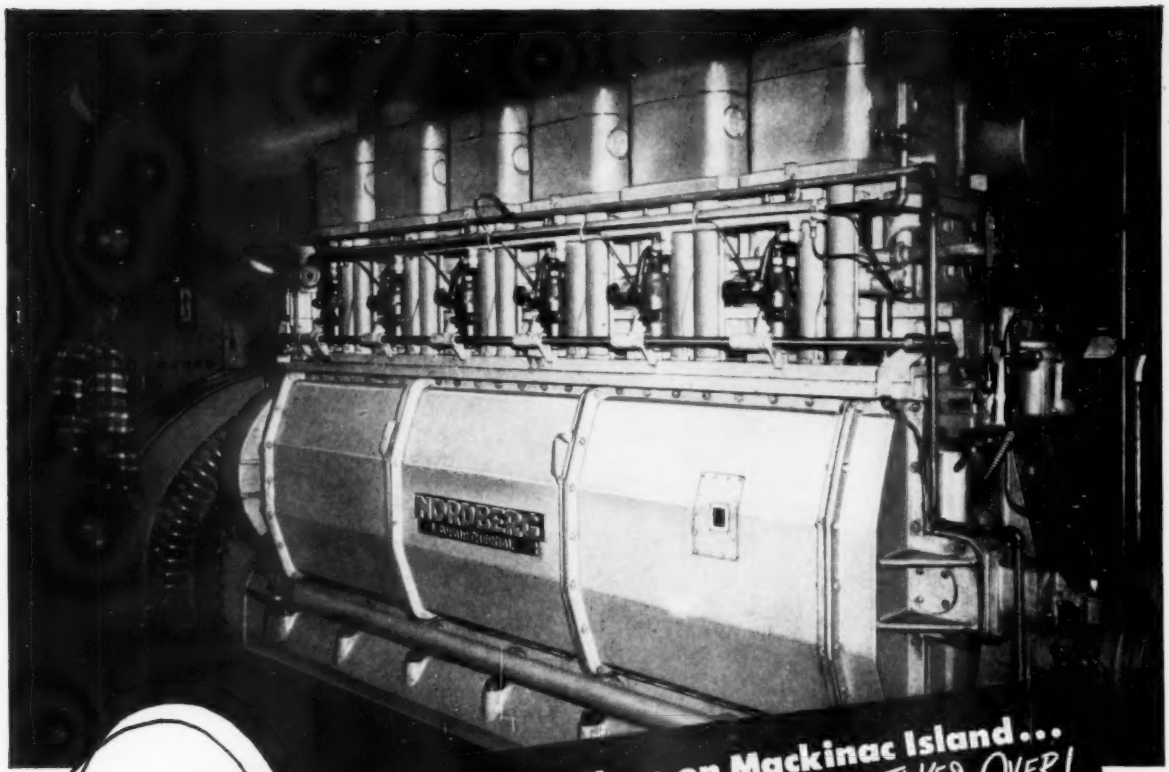
Some pros and cons on atomic energy

• FORD MOTOR CO is conducting special research to develop metals that will withstand the terrific heat of atomic disintegration. The company emphasizes there is nothing to indicate that autos will be powered by atomic energy, but it cannot dismiss this idea simply because so little is known about the application problems.

• UNIVERSITY OF UTAH, with the cooperation of five railroads and nine manufacturing corporations, has developed a design for an atomically powered locomotive. The reactor for the proposed locomotive is already on the designing boards of the Babcock & Wilcox Co. It will be the fluid-fuel type and will use demineralized light water as coolant.

Although the reactor can be designed, B&W feels that problems of heat exchange, corrosion and neutron damage will determine how soon the locomotive itself can be built. The final unit is expected to combine the power of four diesel units with the pickup of an electric locomotive. Electricity, generated by a steam-driven turbine, will supply power for the unit. Although cost estimates are very rough, it has been predicted that "the proposed locomotive will compete successfully with diesels."

For coming events see page 246



Emergency power failure on Mackinac Island... Nordberg SUPAIRTHERMAL Diesel TAKES OVER!

● Electric service reaches Mackinac Island via submarine cable from the Michigan Upper Peninsula. When this cable was damaged recently, main power on the Island was interrupted about eight days, while special equipment was moved in to raise the cable and splice the break. According to the Edison Sault Electric Company, *"If the new Nordberg standby engine had not been immediately available . . it is questionable whether or not service could have been maintained . . ."*

MACKINAC ISLAND, famous northern Michigan resort area, is served by the Edison Sault Electric Company, progressive utility with headquarters in Sault Ste. Marie, Mich. When unusual circumstances caused a temporary main power failure recently, the job of supplying the necessary electric power to Mackinac Island residents was immediately assigned to a new Nordberg 1200 hp *SUPAIRTHERMAL* Diesel Generating Unit.

Installed on Mackinac Island for emergency, as well as "peaking" service during the heavy tourist season, the new 800 kw Nordberg Diesel "took over" the full demand for about eight days, while the primary power line was being repaired. This installation is a good example of Nordberg engines serving the country's utilities, for both standby and main power supply. The next time you have a power problem, think of *Nordberg* . . . builder of America's largest line of heavy duty engines from 10 to over 10,000 hp. *Nordberg Mfg. Co., Milwaukee, Wis.*

NORDBERG

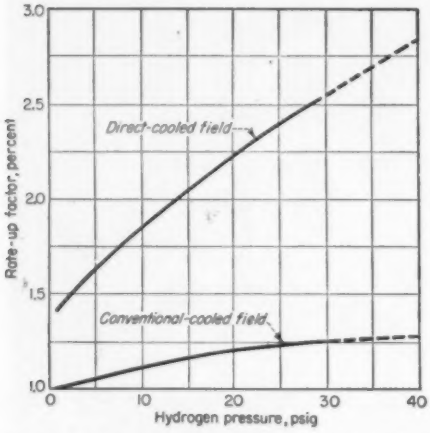
DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

P254

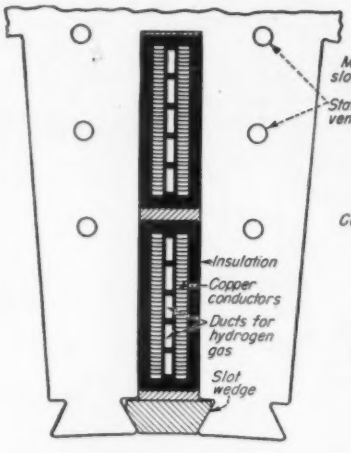
TECHNICAL BRIEFS

Latest engineering developments for busy power men

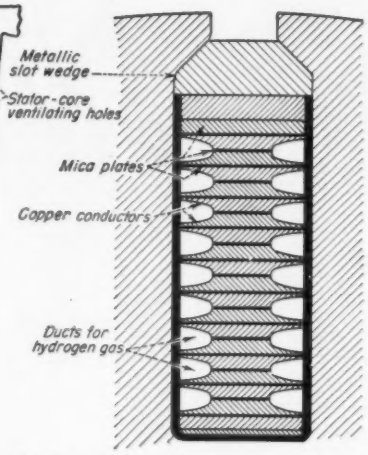
8 Digests for you on:
GENERATOR COOLING
HYDRO DEVELOPMENT
POWER STATIONS



1 Rate-up curve shows how direct cooling aids capacity of ac generation



2 Gas flowing through tubes in center of each coil cools the stator coils



3 Rotor-coil cooling uses end-to-end gas flow through the conductors

Cooling to-day's large ac generators

Direct Cooling of Turbine Generator Field Windings. *By C H Holley and H D Taylor, both of General Electric Co.*

This paper describes an improved cooling system for field windings of turbine generators. Heat is removed directly by cooling gas blowing through passages inside winding conductors, thus eliminating thermal drop in ground insulation. This method is called direct cooling. With this system, much of the rotor-cooling gas is picked up by scoops from air gap between stator and rotor instead of all of it being blown in from end of rotor through internal passages, and is called an air-gap pickup of direct cooling. It has been applied to the field of a 125,000-kva generator (30 psig gas pressure) that was completed in 1953 and that was subjected to a comprehensive test program before being shipped to Niagara Mohawk Power Co for the Huntley Station in Buffalo.

Based upon low temperature rise observed in factory tests, rate-up possibilities of Huntley air-gap pickup-type field are shown in upper curve, Fig. 1, as compared with lower curve representing performance of conventional-cooled field. It should be noted that direct-cooled field will carry about twice the ampere-turn capacity of a conventional field at 30 psig, and that even at 0.5 psig, its capacity is about 40% greater.

Because of characteristics that limit direct gas cooling of armature windings, liquid cooling of these windings seems to offer greater possibilities than gas cooling. It requires only a small fraction of pumping power needed to do the job with gas. Liquid cooling seems so promising that an order has been placed for a 260,000-kva, 0.80 power-factor, 3600 rpm, 18,000 v generator which is being built with a liquid-cooled armature winding. This machine will be installed in East Lake Station of Cleveland Electric Illuminating Co. It will have a field of the air-gap pickup direct-cooled type similar to Huntley.

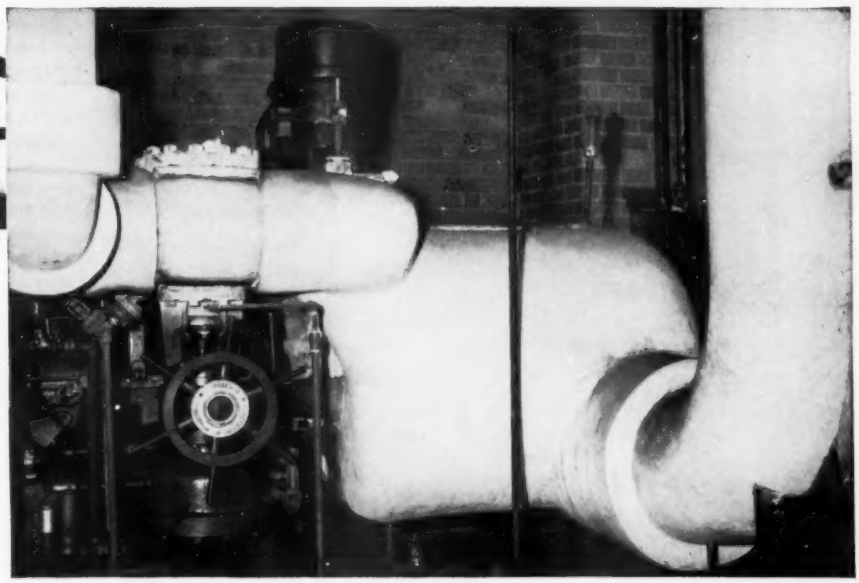
Direct cooling of field and armature winding opens new possibilities for great increases in output obtainable from single generators. Generators of 350,000 or 400,000-kva capacity at 30 psig hydrogen pressure, and even larger, are immediately practical, within weight and dimension limitations set by railroad transportation. Application of these principles to cross-compound sets would, of course, make available turbine-generator units of about double these capacities. *AIEE paper, No. 54-49.*

A New Fully Supercharged Generator. *By Sterling Beckwith and L T Rosenberg, both of Allis-Chalmers Mfg Co.*

Several generators with supercharged rotors are in operation, first having been installed 2½ years ago. At that time it was known that supercharged internal-conductor cooling could also be applied to stator winding and stator core, as well as to rotor. It is only by application to entire machine that full value of method can be realized. This paper describes such a machine which has been built and has an AIEE-ASME standardized rating of 40,000 kw, except that gas pressure required is 30 psig instead of ½ psig. Overall rating of new machine in kilowatts will be limited by turbine capacity. Its overall rating in kva will be limited by how large an exciter is used, but this will probably be 60,000 to 70,000 kva and 45 to 60 psig gas pressure.

Stator coils are cooled by gas passing through rectangular metal tubes in center of each coil, Fig. 2. These tubes are the depth of several strands of conductor, and consequently should be made of high-resistance material, such as monel metal or stainless steel, to keep eddy current losses low. Rotor-coil cooling, Fig. 3, also uses end-to-end gas flow so that it matches stator-core and stator-coil cooling. This is a considerable improvement mechanically from previous supercharged rotors in that it elimintes need for gas discharge ducts in center of rotor. Rotor stray and windage losses and part of stator-tooth losses are taken care of by gas in air gap. This

For this addition to their New York City power plant at East River and 14th Street . . .



(Above) View of recently completed annex to Consolidated Edison's power plant . . . another link in their gigantic expansion program. **(Right)** Close-up of J-M 85% Magnesia Insulation on boiler feed lines. It was expertly installed by the Asbestos Construction Company, Inc., an outstanding J-M Insulation Contractor.

CON EDISON SPECIFIES J-M 85% MAGNESIA PIPE INSULATION FOR MAXIMUM FUEL SAVINGS

Like all materials that went into the new power plant addition of New York's leading gas and electric supplier . . . the pipe insulation had to be the *best*. That's why Consolidated Edison Co. specified J-M 85% Magnesia . . . industry's No. 1 insulation for many decades and *still* the leader in its class.

J-M 85% Magnesia is the leading insulation on the market for temperatures up to 600F. It is bonded with asbestos fibers. This rugged insulation will not distort regardless of the length of time it stays in service. J-M 85% Magnesia fits snug and stays put. Heat savings, therefore, remain constant for the life of the equipment on which this insulation is applied.

For temperatures over 600F, J-M 85% Magnesia is used in combination with Superex*, a J-M insulation for service to 1900F. This double-layer construction, known as Superex Combination, eliminates through joints and protects the jacket against scorching. It also utilizes the higher heat resistance of Superex next to the hot surface, and the greater insulating value of J-M 85% Magnesia for the outer layer.

Reg. U.S. Pat. Off.

Experience has proved that all insulations must be properly installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced insulation engineers and installation contractors who have made a career of solving complex insulation problems. From coast to coast, these engineers and the contractor's highly skilled mechanics stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings through the years.

When you face your next insulating problem . . . remember that Johns-Manville is "Insulation Headquarters." Consult your near-by J-M Insulation Contractor . . . or write direct to Johns-Manville, Box 60, New York 16, New York. In Canada, write 199 Bay Street, Toronto 1, Ontario.

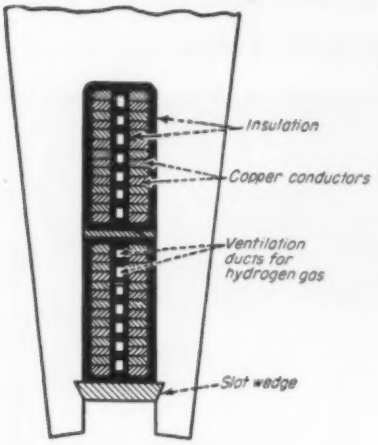
Skilled Applicators on the team of a J-M Insulation Contractor applying J-M 85% Magnesia to pipelines. Located throughout the nation, these contractors have had years of experience handling all types of installations. They know J-M 85% Magnesia and other J-M insulations as *quality* products, and take pride in applying them properly. Result: an insulation job that pays dividends through the years in maximum fuel savings.

Johns-Manville *FIRST IN* INSULATION

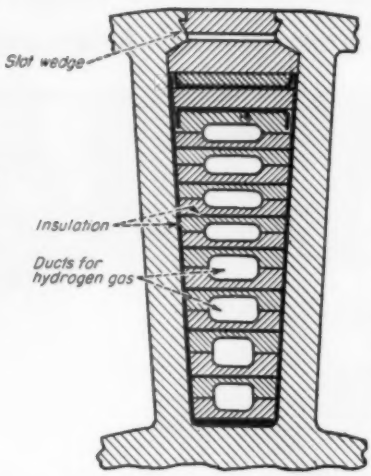
MATERIALS ENGINEERING • APPLICATION

More TECHNICAL BRIEFS

Begins on page 158



4 Cooling tubes in stator coils are of thin-walled non-magnetic material



5 Cooling ducts in rotor are formed direct from channel-like conductors

gas is controlled, as has been done before, by a restricted clearance in end of air gap.

Short rotor removal distance of this 40,000-kw machine will save 10 ft of power-plant width with corresponding reduction in crane span and lifting capacity where stator is heaviest piece to be handled. Stator weight of this new design is only a fraction of that for conventional cooling. Corresponding reduction in plant width for a 150,000-kw standardized unit would be 22 ft and at least 11 ft of foundation length can be saved.

Present completely supercharged generator is in many ways simpler and more rugged than partially supercharged generator of two years ago. It takes full advantage of increased gas pressure and has virtually no load limit because of temperature. Its axial core length is less than half that of equivalent conventional-cooled machine and its average differential temperatures are lower. These lower differentials reduce the seriousness of the problem of differential expansion quite considerably.

By more effectively using internal space, quantity of gas in wholly supercharged generator has been cut to about one-fifth of volume in its conventional predecessor. Its small bearings and seals reduce lubrication needs, hydrogen consumption and mechanical maintenance. Weight and size reduction permits complete factory assembly of largest machine and shipment without dismantling. It also affords user substantial economy in power-plant space and cost. *AIEE Paper, No. 54-48.*

Additional Design Features of the Fully Supercharged Generator. *By B M Koetting and G W Staats, both of Allis-Chalmers Manufacturing Co.*

Fully supercharged generator described in preceding paper No. 54-48 includes a number of innovations in both electrical and mechanical design that, in a conventionally ventilated machine, have not been feasible. Construction of fully supercharged machine uses special characteristics of hydrogen to their fullest extent. This permits inclusion of many normal design features that have influenced most major parts of machine. Some of the improvements in electrical design depend on improved mechanical design. Other mechanical variations have been introduced because they are inherently superior. All these features are described in this paper. *AIEE Paper, No. 54-92.*

Ventilation of Inner-Cooled Generators. *By R A Baudry and P R Heller, both of Westinghouse Electric Corp.*

The electrical power industry has been expanding at such a high rate during recent years that generating capacity is being doubled about every decade. In parallel with growth of power system, there has been a corresponding increase in demand for high-speed generating units of larger ratings.

Increases in generator size were limited principally by mechanical requirements. Rotors were rapidly approaching a point where strength and size of forgings available would prevent any additional increase in diameter within foreseeable future. Further restrictions were imposed by permissible shipping dimensions which determined maximum size of frame housings that may be constructed as integral units.

To remove these limitations, it was necessary to develop more effective cooling means by which thermal barrier of electrical insulation could be eliminated. This objective could be realized by circulating coolant in direct or nearly direct contact with conductors. Westinghouse has recently shipped its first complete inner-cooled turbine generator. In this unit, both rotor and stator coils are directly cooled to satisfy base requirements of 80,000 kw at 30 psig with capacity rating of 100,000 kw at 45 psig.

Inner-cooled stator coils consist of conventional stack of insulated conductor strands separated by a group of rectangular metal ducts, Fig. 4. These thin wall ducts are drawn from high-resistance non-magnetic material to reduce eddy-current losses. Since these tubes are closely coupled by capacitance to conductor, they operate at same potential and need only be insulated in same manner as individual conductor. In inner-cooled rotor the cooling gas flows through ducts formed directly from the conductors. The straps are constructed in a channel shape, Fig. 5, placed together to form rectangular ducts. Two conductors form a parallel turn so that no insulation is required between channel legs. Insulation between successive turns is confined by channel backs, where it is removed from the ventilation passages.

First inner-cooled generator will operate at 45 psig, or its maximum rating of 100,000 kw. During shop tests on this unit, several temperature runs were made at pressures of 96 psig. Such pressure does not offer any particular problem from either designing or operating

(*Continued on page* 224)

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not POWER.

American Institute of Electrical Engineers, fall meeting, Nov 2-6, Kansas City, Mo. and winter general meeting, Jan 18-26, New York, N. Y. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, N. Y.

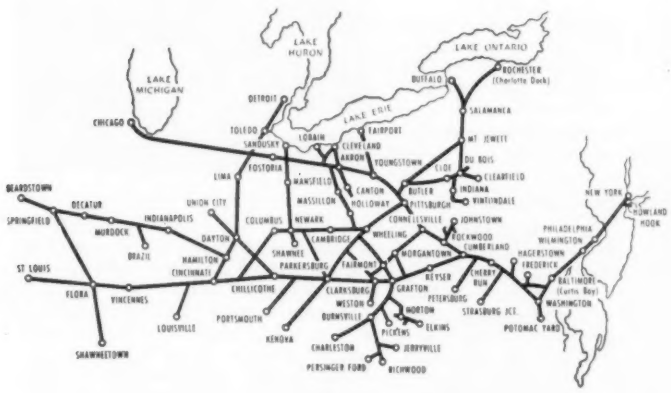
Your "burning question" is quickly answered—with

B&O Bituminous

Whether your specific question concerns power, coking, steam, or space heating, you'll find the perfect answer among the wide variety of Bituminous coals in Baltimore & Ohio territory. Here lies an almost inexhaustible source of low-cost heat and energy.

The benefits of B&O Bituminous are many. Highly mechanized mines keep production costs low, size and quality uniform. Closeness to America's industrial heart means economical transportation. The ease of storing coal eliminates the need for expensive facilities. And new methods and devices take further advantage of the burning characteristics of Bituminous.

ASK OUR MAN! He will help you find the exact coal for your purpose, and explain the best way to burn it. You'll be amazed at the efficiency, economy, and cleanliness of B&O Bituminous today.



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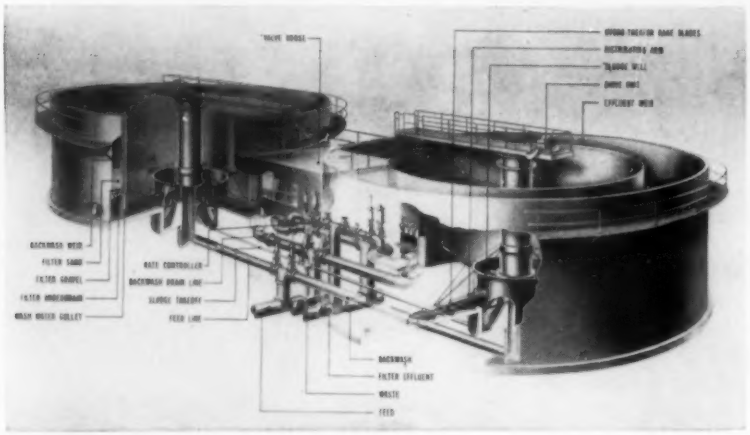


New Water Purification Unit Combines Pre-treatment and Filtration in Single, Compact Installation

400 • New *PeriFilter* system consists of single compact unit for pre-treatment and filtration of municipal and industrial water supplies. Mechanical pre-treatment unit removes color, hardness, iron, manganese or turbidity from raw water; annular rapid-sand filter removes residual turbidity and bacteria.

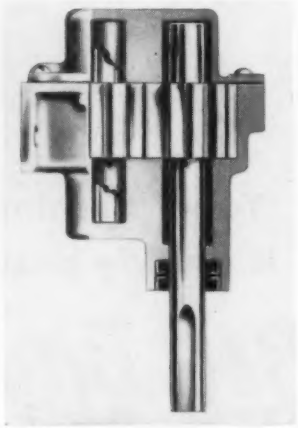
Unit is available as a complete assembly and can be designed into any water purification plant. Each unit includes pre-treatment mechanism, filter bottom and sand, steel tanks and walkways, hydraulic valves, rate controllers, instruments and panel boards plus adjacent valve housing.

Single standard units are now available in wide range of sizes for capacities of from 0.1 to 5.0 mgd.

Where adequate treated water storage is available, a single unit will suffice. However, manufacturer recommends installation of at least two units to provide uninterrupted flow of treated water during backwashing operation. Initial installed costs are reportedly 40% below conventional plants; decreased head losses through plant and simplified operation combine to lower operating costs.

Further details on design and construction available on request to manufacturer.

Dorr Company, Engineers, Stamford, Connecticut

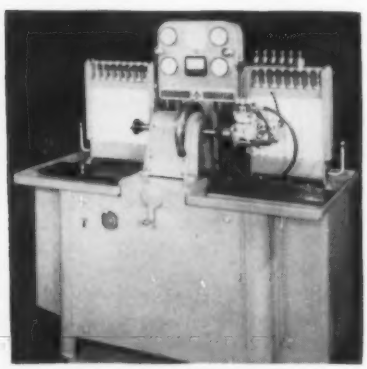


Gear-type Pump

430 • New gear-type pump handles wide variety of pumping problems: light liquids at 1725 rpm or heavy liquids at slower speeds. Unit can handle pressures up to 100 psi, operate equally well in either direction. It is available as a complete unit with pump, base, coupling and motor; as complete assembly less motor; or as replacement with pump only. Complete details on capacities and sizes available.

Eclipse Fuel Engrg Co, Rockford, Ill.

For more data on these items, use post cards p 171. Identify your request with item number.



Pump Calibrator

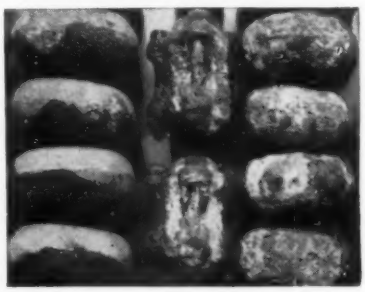
419 • Universal test stand calibrates all popular makes of multi-plunger and distributor types of fuel injection pumps including *American Bosch APE* and *PSB* pumps, *International Harvester* pumps and *Cummins* pumps. *GP 400 Calibrating Stand* permits any mechanic qualified to handle diesel repair work to calibrate and adjust injection pumps to restore original factory settings after rebuilding or repairing. Full details available from manufacturer.

Bacharach Industrial Instrument Co, Pittsburgh 8, Pa.

Steam Measurement

470 • Newly engineered equipment package makes possible measurement of steam under widely different load conditions. Principle involves division of flow from high to low range shunt flow meter whenever demand on system is low. System provides following advantages: metering over wider range, increase in annual revenue, prevention of overload and subsequent damage to low range meter, elimination of need for condensate meter with return lines and attendant maintenance problems. Application Memo No. K19 available on request.

Builders-Providence, Inc, 345 Harris Ave, Providence, R. I.



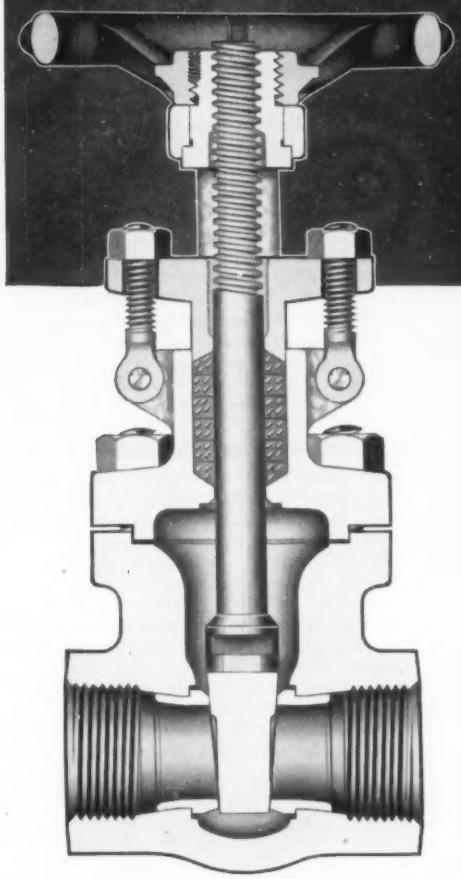
Coating Material

443 • New coating material shows extremely promising results in tests under highly corrosive conditions extending over period of more than two years. Coating is a mixture of finely pulverized aluminum powder in special plastic vehicle; metallic particles comprise about 85% of mixture. Coated sections under test were placed in contaminated salt water with a pH of 4-5. Photo shows how *Kolmetal* coatings, applied to stacks at left, kept sections clean and free of corrosion. Full details available on request to manufacturer.

National Radiator Co, Central Ave, Johnstown, Pennsylvania

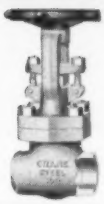
You get Big Valve quality in these

SMALL 600-POUND STEEL GATES by CRANE



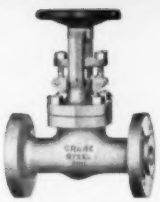
BOLTED BONNET OR UNION BONNET

In the cross-section of the bolted bonnet pattern above, you can see the rugged *big-valve* construction. Bolted bonnet valves available in sizes ½ to 2-inch—union bonnet valves in sizes ¼ to 2-inch.



Screwed Ends—Union Bonnet or Bolted Bonnet

Socket-Welding Ends—Bolted Bonnet or Union Bonnet



Flanged Ends—Bolted Bonnet only

Look no further for dependable steel valves in sizes up to 2-inch. Whether you prefer the union bonnet or bolted bonnet pattern, you get refinements usually found only in larger, more expensive valves.

For example, you get a compact, weight-saving structure of high-quality carbon steel. Smooth operation and positive closure of the solid wedge disc are assured by a T-head disc-stem connection and full-length machined guide ribs. There's also an unusually large stuffing box filled with high-grade packing, a leakproof bonnet joint with retained gasket, a husky stem with outside threads, and many others. To simplify maintenance, Crane design includes swinging gland eye-bolts—plus a wide yoke with liberal working space around the gland.

USER'S CHOICE OF TRIM

There's versatility to these quality Crane steel valves, too. You can have your choice of trim to suit your service—Class X Trim (Exelloy body and body seat rings) for oil or oil vapor—Class XW Trim (Exelloy seat rings, disc of hardened stainless steel) for steam or water. Union bonnet valves also available with Class L Trim (18-8 Mo Alloy seats, disc, stem) for liquids and gases up to 750° F.

Full details in 6-page folder AD-1881. Ask your Crane Representative next time he calls, or write direct.

THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
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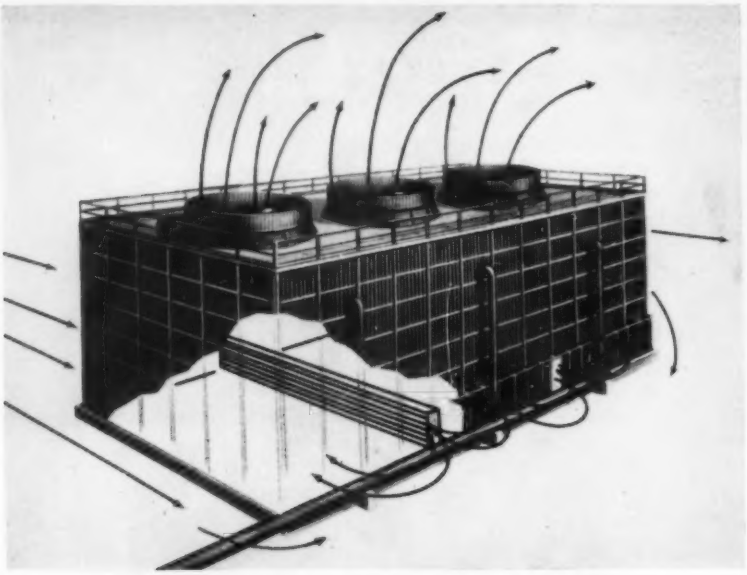
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

More EQUIPMENT NEWS

Begins on page 162



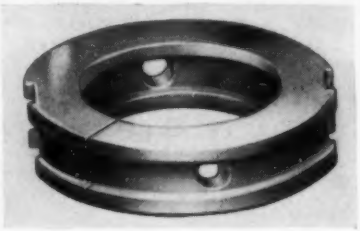
New Cooling Tower Minimizes Recirculation

403 • First significant progress toward control of recirculation in cooling towers results from entirely new engineering and design feature using *Equalizing Channels* between each cell of tower. According to manufacturer, this balances pressure and reduces the recirculation that so often impairs performance of cooling towers.

Equalizing Channels in large multi-cell towers relieve pressure differential existing between windward and leeward sides and prevent exhausted air from being forced into inlet area and recirculated. During strong horizontal winds, channels allow air to pass completely through tower so as to equalize pressure.

Recirculation varies with every type of tower installation but always determines cooling tower performance. Manufacturer claims that *Equalizing Channels* will, under all atmospheric conditions, balance pressure and reduce recirculation.

Santa Fe Tank & Tower Co, Los Angeles, California



Teflon Sea Cage

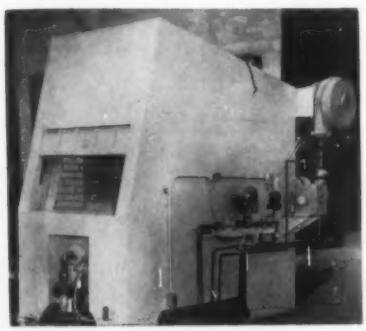
432 • New one-piece *Teflon* seal cage, for use with stuffing boxes on processing equipment, overcomes handicaps experienced with two-piece metal lantern rings. *Chempro* seal cages, machined in one piece, can be snapped over shaft easily without dismantling pump or pulling shaft. They will not score shaft yet will not bend or collapse under extreme gland pressure. Units are available in standard or special sizes to fit any pump, mixer or agitator.

Chemical and Power Products, Inc, New York, N. Y.

High Capacity Chlorinator

469 • New line of high capacity chlorinators offers unique features of simplicity, wide operating range and dependability. They are adapted to municipal and industrial chlorination. Contributing to unit's ease of maintenance is its resistance to both wet and dry chlorine—resistance achieved by construction materials such as Uscolite, Teflon, Kel-F, Hastelloy "C," monel, silver and tantalum. Full details on construction, accessories and operation available on request to manufacturer.

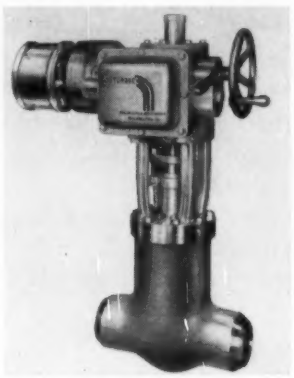
Fischer & Porter Co, 16 Jacksonville Rd, Hatboro, Pa.



Recirculating Furnace

422 • Modernized convection recirculating forced-draw furnace has built-in fan that forces hot gas through work chamber at rate of 70 cycles/min. Sloping front design assures tight sealing of air-actuated door, insures maintenance of predetermined temperature right up to door without any cool area. This increases actual usable space by 15%. Temperature ranges from 250 to 1250 F. Furnace conforms with factory mutual safety standards.

Bellevue Industrial Furnace Co, 2620 Crane Ave, Detroit 14, Mich.



Valve Control

421 • New *SMA Limitorque* automatic valve operator incorporates following improvements: greater torque, thrust and stem capacity; easier de-clutching and hand-wheel operations; 2-piece stem nut design; improved switch design and electrical arrangement; torque control for both directions of stem travel, or just in a single direction if desired. Full information in manufacturer's bulletin.

Philadelphia Gear Works, Inc, G St & Erie Ave, Philadelphia 34, Pa.

Fans

447 • These fans, with cast iron housing and base, are available in two different types: The *LV*, large volume, is available in four sizes with forward curved wheel of all-welded construction that is both statically and dynamically balanced. The *PB*, pressure blower, uses radial-bladed wheel of aluminum alloy. Detailed specs and information available in manufacturer's bulletin MD-101.

Chicago Blower Corp, 9867 Pacific Ave, Franklin Park, Illinois

For more data on these items, use post cards p 171. Identify your request with item number.

Keeping Thermal Expansion Under Control

Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.

Heat 100 linear feet of alloy steel pipe to 1000° F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

Safety of entire system at stake

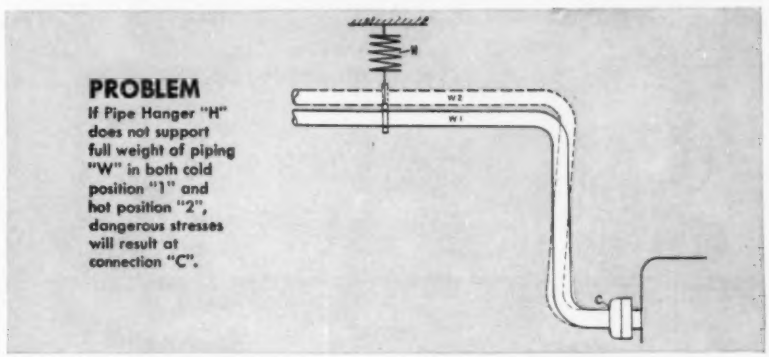
Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

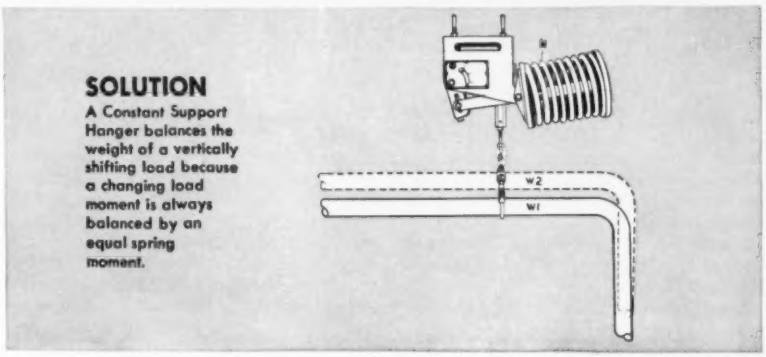
With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

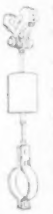
The case for constant-support hangers

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.


PROBLEM
If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".
W2
W1
C

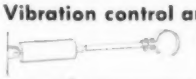

SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.
W2
W1



Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

Hanger Engineering Service

The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

Grinnell manufactures a complete line of pipe hangers and supports; maintains an experienced laboratory staff of technicians to discover better ways of solving pipe suspension problems; provides engineering assistance in design and installation; offers stocks of pipe hangers close to any job.

Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.

GRINNELL COMPANY, INC.

278 West Exchange St., Providence, Rhode Island

Kindly send me a complimentary copy of your "Hanger Load Calculations" booklet.

Name.....

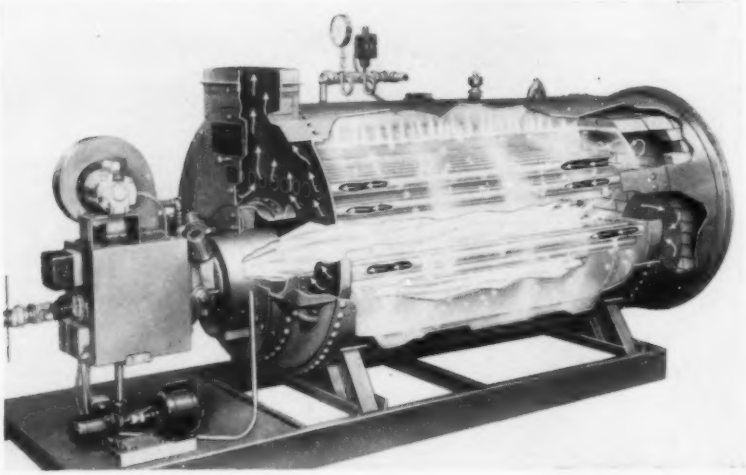
Company.....

Address.....

City.....State.....

More EQUIPMENT NEWS

Begins on page 162



Packaged 125-hp Boiler Permits Extremely High Heat Output

401 • New self-contained fully-automatic Scotch-marine boiler produces 125-hp maximum rating without pushing or straining. Design and construction equals or exceeds all latest requirements of ASME Code and *Code of Ethics* of Industrial Gas Equipment Division of GAMA.

Special features of the boiler, according to manufacturer, are its larger than average steam space, combustion area, water storage area, and heating surface. Tests prove the new 125-hp unit permits extremely high heat output without strain or danger of heat cracks, produces hot dry steam, and develops rated hp efficiently under normal operating conditions.

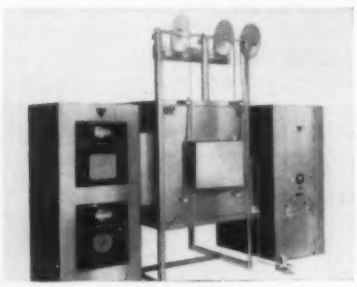
Boilers are available for burning gas, gas or light oil, gas or heavy oil, oil only and heavy oil only (requiring preheat). For details and delivery, contact manufacturer.

Eclipse Fuel Engrg Co, 1002 Buchanan St, Rockford, Illinois

Steam Traps

417 • New *Heat-Kwik Super-Silvertop* steam traps reportedly vent air out of steam consuming units eight times faster than ordinary inverted-bucket traps and three times faster than air eliminator or blast-type traps. Units accomplish rapid air venting through the use of two separate orifices, one for condensate and separate bellows orifice for air. These traps require trap factor of never more than 2-1. They are available in sizes ranging from ¾ to 1¼ in. suitable for pressures up to 150 psi. Additional information, literature and prices available on request to manufacturer.

V D Anderson Co, Cleveland 2, Ohio



Package Temperature Control

406 • Packaged temperature control, *Wheelco Capacilog*, of general purpose heat-treating furnace provides continuous automatic control and permanent records of all temperatures up to 2700 F. Simple plug-in design offers extremely flexible control and simplifies routine maintenance. After start-up, unit maintains program without supervision or adjustment. Heating and cooling cycles range from four hours to seven days.

Barber-Colman Co, Wheelco Instr Div, Rockford, Illinois

Portable Filter

431 • Portable filter comes completely equipped with pump, motor, oil-resistant hose, gauges and filter. Standard design shown above is equipped with ½-hp motor and 4-gpm gear pump. Filter guarantees removal of all particles down to 25 microns. Other features for special designs are centrifugal pumps, higher capacities and degrees of filtration of 10 and 50 microns. Full details available on request.

Cuno Engrg Corp, Meriden, Conn.

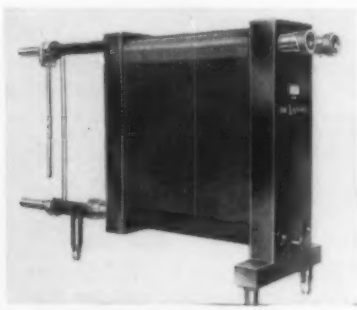


Plate Heat Exchanger

418 • New plate heat exchanger is especially well adapted for industrial process applications wherever heating, cooling or regeneration are required. Outstanding feature lies in the plates themselves: pressed from extra-heavy stainless steel stock, and including deeply corrugated surface, they resist distortion and withstand higher than average operating pressures. Corrugated design results in high velocity and extreme turbulence of liquid; heat transmission coefficient is unusually high.

Liquids cannot leak between plates nor mix with cooling or heating medium. Cooling, heating and regeneration are readily accomplished, simultaneously, in various sections of the unit. Plates are invertible, may be changed from time to time according to changes in operation. Two-point tightening arrangement guarantees uniform pressure on the plates. Exchangers are available in wide range of sizes and models.

DeLaval Separator Co, Poughkeepsie, New York

For more data on these items, use post cards p 171. Identify your request with item number.

"You see POWELL VALVES everywhere!"

Not surprising when you realize that Powell makes more kinds of valves and has probably solved more valve problems than any other organization in the world. And this has been going on since 1846.

Wherever flow requires dependable control, there's the place for Powell Valves—available through distributors in principal cities. Made 1/8" to 30" and 125 pounds to 2500 pounds W. S. P. Bronze, iron, steel and corrosion resistant alloys. On problems, write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

Powell Valves

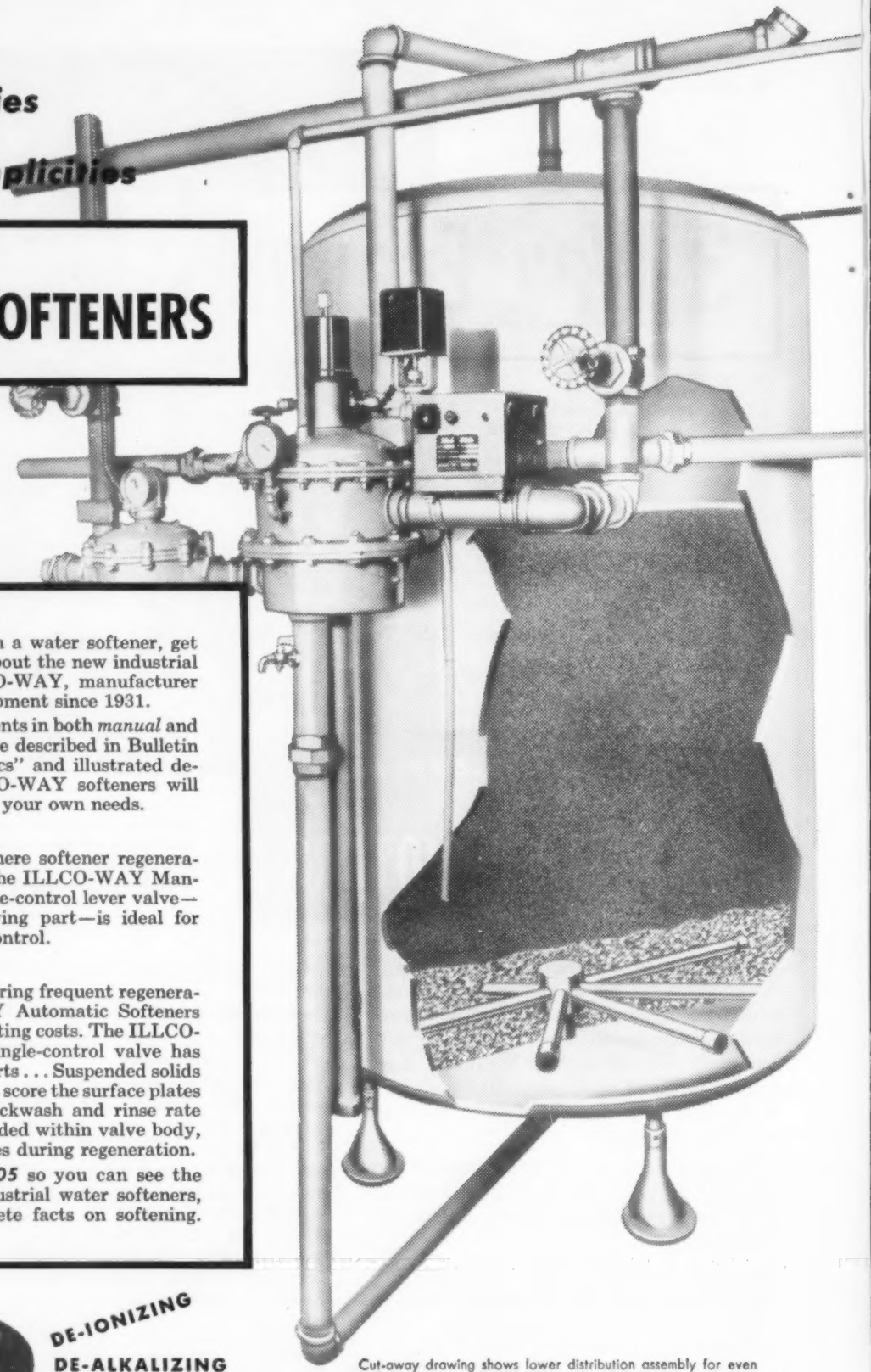
108th year

New economies

New simplicities

ILLCO-WAY

WATER SOFTENERS



Before you invest in a water softener, get eye-opening facts about the new industrial softeners by ILLCO-WAY, manufacturer of ionXchange equipment since 1931.

Recent developments in both *manual* and *automatic controls* are described in Bulletin 105. Complete "specs" and illustrated descriptions of ILLCO-WAY softeners will help you to analyze your own needs.

Solo Matic Valves

For installations where softener regeneration is infrequent, the ILLCO-WAY Manual multi-port, single-control lever valve—with only *one* moving part—is ideal for complete manual control.

Aqua Matic Valves

On equipment requiring frequent regenerations, ILLCO-WAY Automatic Softeners save time and operating costs. The ILLCO-WAY Automatic single-control valve has only two moving parts . . . Suspended solids in raw water will not score the surface plates of the valve . . . Backwash and rinse rate controllers are included within valve body, for proper flow rates during regeneration.

Write for Bulletin 105 so you can see the entire range of industrial water softeners, and get the complete facts on softening.

ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

Cut-away drawing shows lower distribution assembly for even flow throughout the resin bed, assuring full exchange capacity.

ILLINOIS WATER TREATMENT CO., 853-4 CEDAR STREET, ROCKFORD, ILLINOIS • 141 E. 44th STREET, NEW YORK 17, N. Y

Canadian Distributor: Pumps & Softeners Limited, London, Ontario

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AIR CONDITIONING

1 **Thermostatic control** of temperature in each room with *Selectemp* heating systems. Three-color, 8-page booklet. Photos, dimensional and application sketches, full specs. Catalog 2769, Iron Fireman Mfg Co, 3170 W 106th St, Cleveland 11, Ohio.

2 **Pulpit air conditioner** for use in industrial areas where heat, dirt or fumes create hazardous working conditions. Two-color, 4-page folder. Photos, full specs. Bulletin 1307, Dravo Corp, 1203 Dravo Bldg, Pittsburgh 22, Pa.

BOILERS & AUXILIARIES

3 **Blow-off valves** for boiler pressures up to 400 lb WSP. Full details on seatless blow-off valves and double-tightening blow-off valves. Installation recommendations and construction details. Bulletin B-426, Yarnall-Waring Co, Mermaid Lane, Philadelphia 18, Pa.

4 **Boiler burner unit** for heating power and process steam with oil, gas or gas-oil combination. Full-color, 16-page catalog. Photos, sectional and dimensional drawings, performance curves, full specs. Catalog 1031, Kewanee-Ross Corp, 101 Franklin St, Kewanee, Ill.

5 **Factory-assembled** automatic water-tube steam generators with oil or gas firing. Two-color, 16-page catalog. Photos, cutaway views, installation sketches, full specs. Catalog SB-51, Erie City Iron Works, Erie, Pa.

6 **Cost saving method** for boiler replacement. Three-color, 6-page folder. Photos, diagrams, full description. Crotty Mfg Corp, 133-15 35th Ave, Flushing, N. Y.

7 **Boilers and allied steam** generating equipment. Two-color, fully illustrated booklet. Catalog SB-50, Erie City Iron Works, Erie, Pa.

8 **Automatic boilers** in sizes from 20 to 500 hp with oil or gas firing and working pressures of 15 to 200 lb. Two-color, 6-page folder. Photos, cutaway views, complete description. Bulletin BE3, Continental Boiler Div, Boiler Engrg & Supply Co, Inc, Phoenixville, Pa.

9 **Steam hose applications.** 4-page bulletin. Photos, cross-sections, cutaway views, full specs. Quaker Rubber Corp, Div of H K Porter Co, Inc, Tacony and Comly St, Philadelphia 24, Pa.

CONTROLS, ELECTRIC & MECHANICAL

10 **Safety switches,** circuit breakers, service equipment, open knife switches and accessories. Fully illustrated 1954 General Catalog G 100. Trumbull Components Dept, General Electric Co, Plainville, Conn.

11 **Remote bulb thermometers:** indicating, recording, controlling. Fully illustrated, 44-page general catalog 6709. Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa.

12 **Oil-tight push-buttons,** indicating lights, selector switches and accessories. Full color, fully illustrated, 16-page booklet. Bulletin GEA-5779B, General Electric Co, Schenectady 5, N. Y.

13 **Motor control** centers. Three color, fully illustrated booklet. Bulletin 170, Arrow-Hart & Hegeman Electric Co, 103 Hawthorn St, Hartford 6, Conn.

14 **Electrolytic conductivity** indicator-controller. Two color, four-page folder. Photos and specs. Bulletin 6639D, Industrial Instruments Inc, 89 Commerce Rd, Cedar Grove, N. J.

ELECTRICAL EQUIPMENT

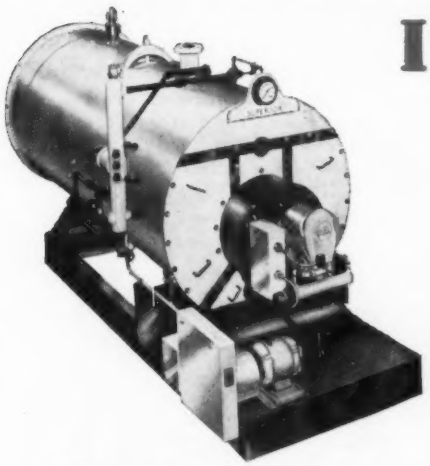
15 **Electric distribution** systems for commercial and industrial applications Two-color, fully illustrated, 56-page general catalog TDA-1, General Electric Co, Distribution Assemblies Dept, Plainville, Conn

16 **Large distribution** transformers (250-500 kva) designed to cope with increased load

(*Continued on page 252*)

Completely "Packaged" Superior Steam Generators on factory test line.

only a TRUE PACKAGED boiler IS TESTED like this.



18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for Catalog 600.

At the Superior factory in Emmaus, Pa., every steam generator is thoroughly tested before shipment. This is one of the outstanding advantages of the *true* packaged steam generator. Completely assembled at the factory with burner and all boiler trim installed, it is set on a testing line, connected to service supplies, and fired. During this test firing period, trained technicians thoroughly check on all points of performance and make whatever adjustments are necessary to bring the unit into top operating condition.

Then, and then only, is a Superior Steam Generator shipped . . . with a written guarantee based on the results of this actual test firing. There's no guesswork about Superior Steam Generators. Every guarantee is based on the actual performance of the unit to which it applies.

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR STEAM GENERATORS

George Edwards' Scrapbook

By today's standards, Edison's first practical incandescant lamp of 75 years ago was very inefficient. For example, it produced only 1.4 lumens per watt of electricity consumed. In contrast, a giant 75,000 watt lamp just built by GE gives out 32 lumens per watt and is one of the most efficient incandescent light sources yet produced—and this isn't the end of development.

* * *

Here's a list of primary abilities you might expect of a man before you give him a job of leadership. This list was made up by George C Houston of General Electric Co. He's in personnel work and has some pretty good reasons backing up each of these items.

1. Willingness to accept responsibility.
2. Ability to command the respect, cooperation and confidence of others.
3. Ability to get at the heart of a problem and to come up with sound plans or decisions.
4. Ability to organize men—and facilities—to translate plans and ideas into action.
5. Ability to see ahead and to understand the implications of decisions or actions.
6. Ability to sell ideas, plans or decisions.
7. Ability to make decisions and to stand behind those decisions.
8. Flexibility, or the ability to adjust to new trends or circumstances and to recognize honestly and admit mistakes when necessary.

* * *

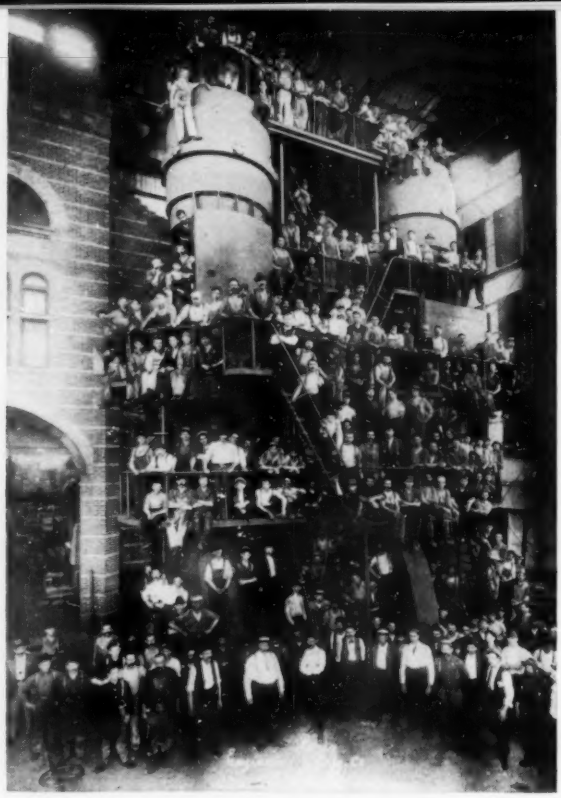
Man is the **merriest** species of the creation; all above or below him are serious. —ADDISON

* * *

Here is a letter from my sister who lives in Granite City, Illinois. Because she is one of the few really happy people I have ever known, I'm printing her philosophy just as she wrote me this morning.

"George, life can be beautiful if you want it to be. It is so easy to be happy; but—you must be busy. I could be happy anywhere because I can adapt myself to my surroundings. I love to work—it keeps me young. I'll never get old and I'll never retire so long as the good Lord gives me health. At 45 I get around better than many younger people I know—because they are always looking for something they can't find—happiness. I've learned that you must create your own happiness. These women are always bored. It never happens to me because I'm too busy thinking of what I must do next."

There it is—take it or leave it.



Thought you readers might like to see this old photo that E R Bonnist of Cooper-Bessemer Corp in Mount Vernon, Ohio sent me. He writes:

"Size dignified horsepower half a century ago when mammoth steam engines like this were installed in manufacturing plants. Posed on this C & G Cooper two-cylinder vertical engine are 300 employees of the Raring Engineering Mfg Co in Tennessee as they were photographed in 1907 on platforms and ladders. Compared to this old giant, one of our modern diesel engines occupies only one-tenth the space."

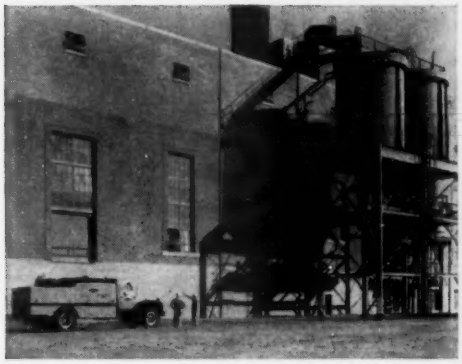
This photo interests me for several reasons: Those are mighty serious-looking mechanics and apprentices. I even detect one or two who might pass for Power's Marmy in his younger day. Then again, comparing this engine to smaller ones of today shows just how far we've come in improving our prime movers during half a century.

If you didn't attend the Instrument Society of America's supper at the Hotel Statler in New York a few months ago, you missed out on a really entertaining talk by Dr. Samuel A Goudsmit. He is senior scientist and chairman of the physics department at the Brookhaven National Laboratory at Upton, Long Island.

Like all really educated people, Dr Goudsmit has a great sense of humor and loves to tell about his amusing experiences in helping to develop atomic energy. But I guess the one really important point he brought out in his talk is that the main thing that pays off in this world is ideas.

George Edwards

300,000 PPH BOILER CLEANED CHEMICALLY IN ONE DAY!



Dowell engineers bring solvents to the job in truck-mounted tanks, along with all pumping and control equipment. They apply the chemicals as necessary—by filling, spraying, jetting, cascading or vaporizing.

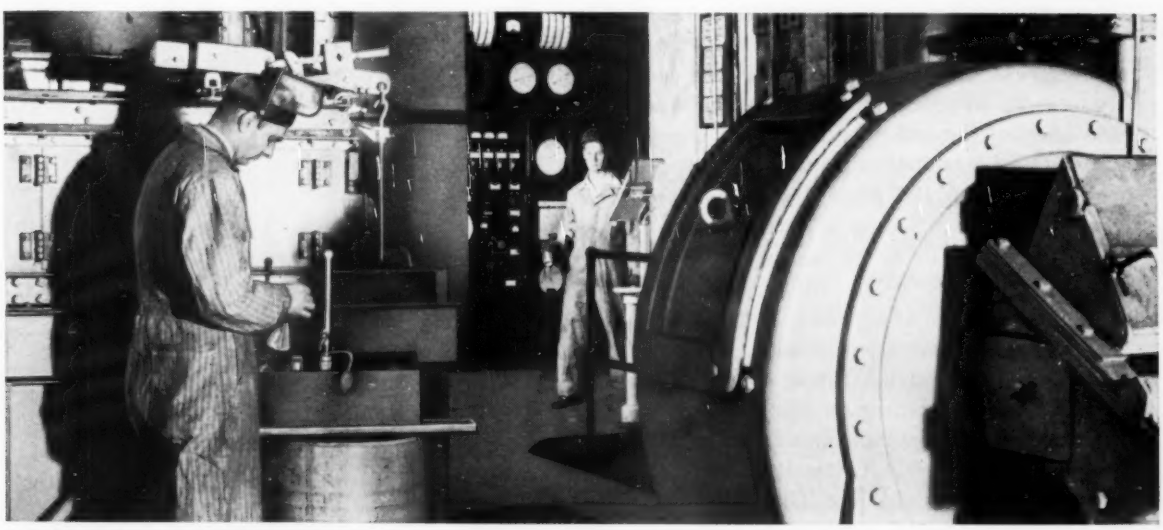
Comparative cases showed DOWELL cleaning took less time . . . removed more scale than mechanical methods

This is a case history on a 300,000 pound per hour boiler in a refinery. A routine inspection showed that iron oxide and silicate scale fouled the tubes. Dowell engineers cleaned the boiler with chemical solvents in less than 22 hours.

Dowell chemical cleaning is the standard method of removing deposits from boilers in this plant. Comparative tests showed that the chemical method was both faster and more thorough than the mechanical means previously used. The operator was surprised at the relatively large amounts of scale and sludge removed by chemical cleaning. Dowell has cleaned 25 of the 27 boilers in this plant. Several have been cleaned as many as three times on an annual basis.

Dowell liquid solvents go wherever steam and water flow, reaching surfaces inaccessible to other methods. No special scaffolding is required. *Dismantling and down-time are kept to a minimum.* Often, equipment may be cleaned while in operation.

Perhaps chemical cleaning could improve the efficiency of equipment in your plant—for example, heat exchangers, piping systems, tanks and process towers. For complete information and estimates, call the nearest of more than 130 Dowell offices, or write directly to Dept. D-23, DOWELL INCORPORATED, TULSA 1, OKLAHOMA.



DOWELL SERVICE

chemical cleaning service for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

FOR VALVES IN CORROSIVE SERVICE

Industrial plants large and small have long been looking for a permanent acid-proof packing.

Up to now braided blue asbestos packing has been considered best and cheapest (60-day life). Today the whole world of packing has been changed by the material, *Teflon*. Braided yarn packing made of Teflon is replacing all forms of braided packing for acid service, because it lasts as long as the valve itself. Practically no acid, diluted or concentrated, hot or cold, has any affect on the packing. It is recommended for services at any pressure, with temperatures ranging from –100°F. to +500°F.

"JOHN CRANE" Style 704 is available in handy coil or spool form in a full range of sizes from ⅛" to ⅜" square.

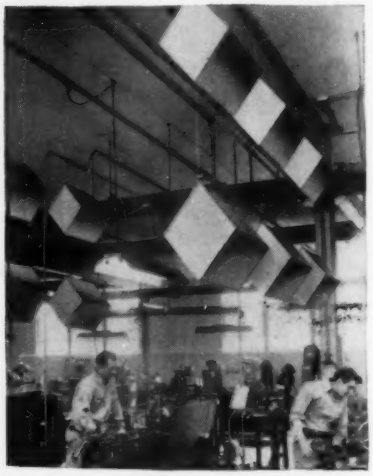
Many Power Plant Engineers are now successfully using "JOHN CRANE" Style 704 Braided Teflon Packings for handling all types of corrosive liquids and gases. For the best in mechanical packings fabricated from braided Teflon, contact Crane Packing Company. *Send for this technical bulletin, containing important data and suggested applications for Teflon.* Crane Packing Company, 1830 Cuyler Ave., Chicago 13, Ill.

*Du Pont's trademark for tetrafluoroethylene resin.

JOHN CRANE CRANE PACKING COMPANY

More EQUIPMENT NEWS

Begins on page 162

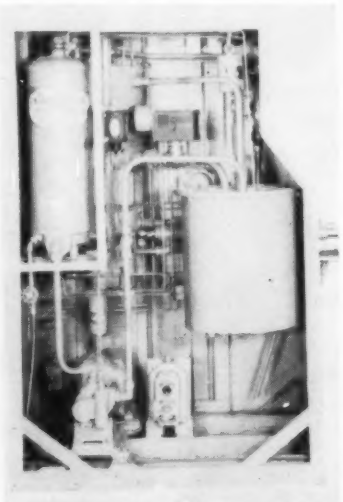


Sound Absorbing Units

413 • New sound absorbing units for industrial applications feature small size, light weight, easy portability, economy and ease of installation. *Sonosorbers* consist of inner cores in perforated stucco embossed aluminum. Units may be clustered or honeycombed or grouped in layers over source of sound. They do not interfere with sprinkling or lighting equipment and are completely fireproof. Shipped knocked down, they can be assembled easily by ordinary maintenance crews. Full details available on request to manufacturer.

Sonosorber Corp, 21 S 16th St, East Orange, New Jersey

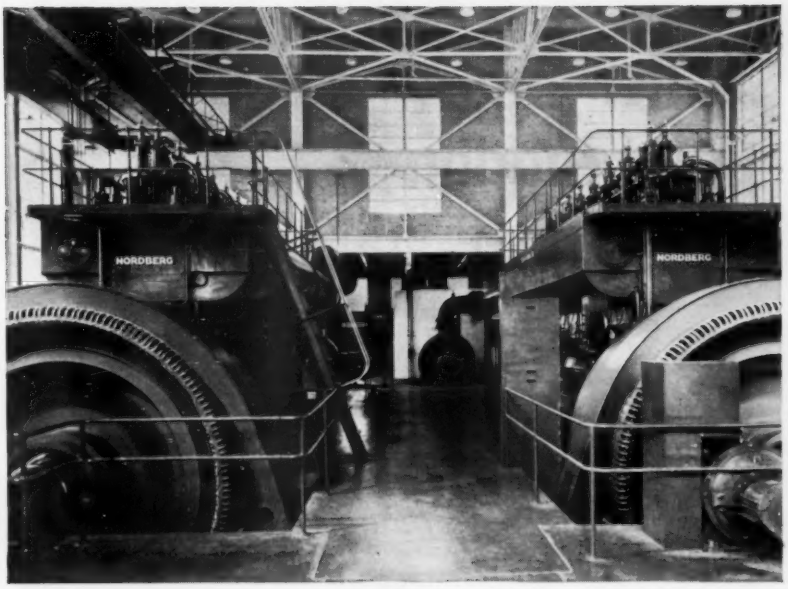
For more data on these items, use post cards p 171. Identify your request with item number.



Lub-Oil Package Unit

408 • New package lubricating unit pumps oil into engines at constant temperature and pressure to simulate actual operation for test purposes. Equipment consists of air-operated valves, 20-gpm pump, filter, heat exchanger, load cell and precision in-

W. T. Elliott,
Power Plant Supt.,
says...



"We've Got Facts to Prove Rubilene's Superiority"

A lot of people depend on Mr. W. T. Elliott. For it's his job as Power Plant Supt. to see that the City of Denton, Texas has unfailing light and power 24 hours a day. To help live up to that responsibility, Mr. Elliott pampers his hard working Nordberg Duafuel® engines – makes sure they're lubricated with the finest oil available. He says, "We've been using Sinclair RUBILENE® since 1948 with *very satisfactory results*. Cylinder liner wear is only ⅓ of 0.001 inch per 1,000 hours running. Piston ring life is 16,000 hours of operation and we get 6,100 H.P. hours per gallon of oil... Facts like those have definitely sold me on RUBILENE."

Why not let the facts prove to you, too, RUBILENE is a superior lubricating oil. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS

save wear and replacements

Water Conservation starts *here*

Take the first step toward efficient water utilization . . . use BUILDERS PROPELOFLO METERS to find out *where* water is used and *how much*. Address . . .
Builders-Providence, Inc.
(Division of B-I-F Industries, Inc.)
354 Harris Ave., Providence 1, R. I.
for free Propeloflo Bulletin.

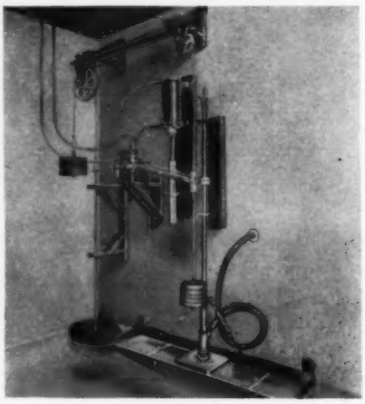
BUILDERS-PROVIDENCE
DIVISION OF B-I-F INDUSTRIES, INC.
BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.
METERS FEEDERS CONTROLS

More EQUIPMENT NEWS

Begins on page 162

dicators, explosion-proof and lockout button. All electrical parts are explosion proof. Further details available on request.

J N Fauver Co, Inc, 51 W Hancock, Detroit 1, Michigan

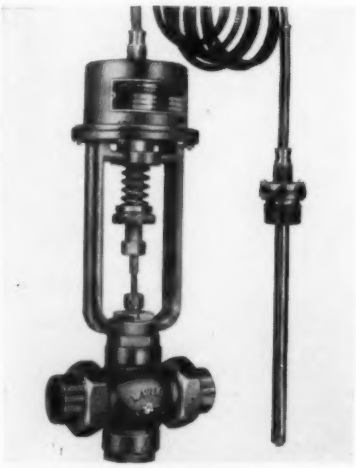


Oil Skimmer

426 • New device for reclaiming oil operates from liquid level in chamber through which waste is flowing. Unit automatically and continuously skims oil from surface regardless of liquid levels in collection tanks or chambers. Oil skimmer consists essentially of four assemblies: (1) movable trough complete with rollers and supporting guide rod (2) hydraulic cylinder with compound lever attachment (3) 4-way hydraulic valve with hydraulic power pack (4) counter-weighted float and cable assembly. Full construction and operation details available on request to manufacturer.

Simplex Valve & Meter Co, 68th & Upland St, Phila. 42, Pa.

For more data on these items, use post cards p 171. Identify your request with item number.

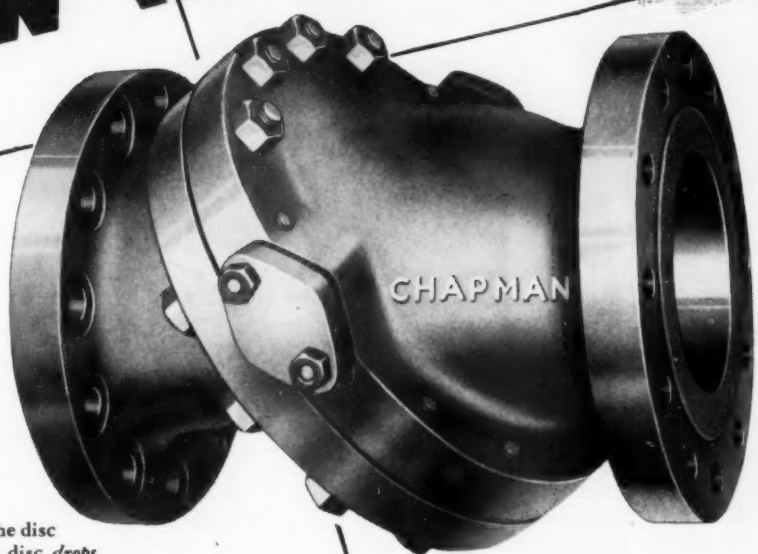


Steam Regulator

427 • New steam regulator has guaranteed self-closing safety feature that absolutely prevents overheating through an override by accidental damage to thermo-

Only Chapman's *Tilting-Disc* Check Valves Give You...

NO SLAMMING
LOW HEAD LOSS
LOW WEAR



Here's the check valve that stays open with minimum flow resistance, closes fast without slamming, closes tight without sliding or scraping wear.

Cushioned Closing

Pressure against the upper part of the disc cushions it as it closes. Then the disc *drops tight* to its beveled seat after the valve has swung closed. Both actions are fast, but they are fluid-cushioned. Seating is quiet in all but unusual piping arrangements.

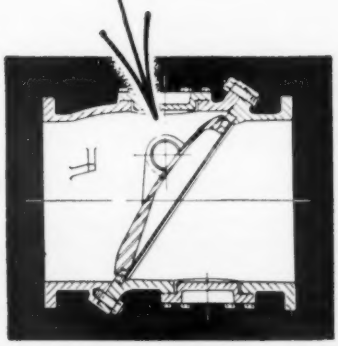
Low Flow Resistance

The streamline design of the valve body and disc eliminate turbulence and cut flow resistance. The fluid holds the disc tightly against its stops, without flutter. The body is larger around the disc, so the net valve area is at least as much as the pipe area.

Minimum Wearing Action

Because the disc *drops* tight, it doesn't slide against the seat. The wear on hinge pins is small because the disc doesn't flutter. Unusually husky construction in every detail means long life under the toughest conditions for Chapman's Tilting Disc Check Valve.

Full engineering and construction data are in Chapman's Catalog #30. Write for it now.



Here's Why CHAPMAN Tilting Disc Check Valves *Keep Quiet* All Their Lives

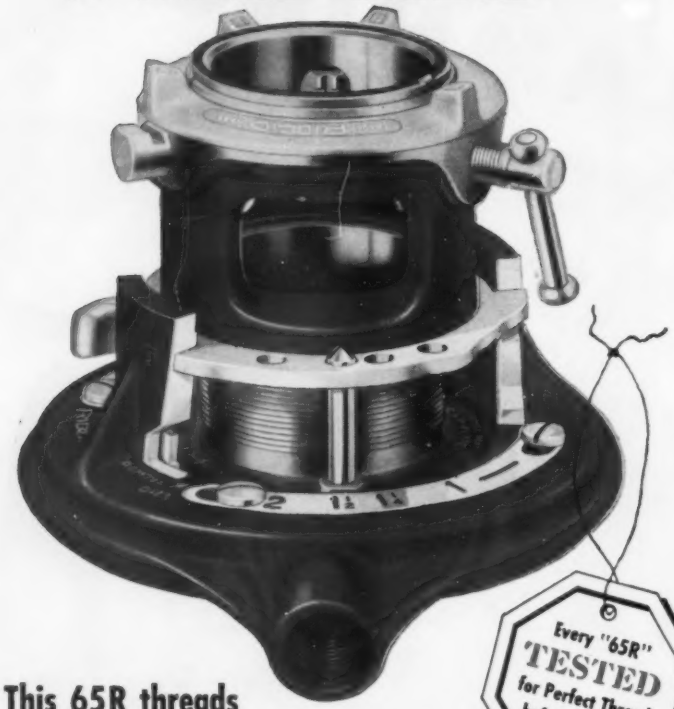
This specially designed "airfoil" disc balances perfectly in open position... then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

The CHAPMAN VALVE Manufacturing Company

INDIAN ORCHARD, MASSACHUSETTS

For Trouble-Free Pipe Threading ...its a 65R

RIDGID



Every "65R" TESTED for Perfect Threads before shipment

This 65R threads 1" to 2" pipe with 1 set of dies ...and it won't jam!

You won't find a die stock to equal this popular 65R—anywhere! It saves time—one set of self-contained high-speed dies adjust to 1", 1¼", 1½" or 2" pipe or conduit in 10 seconds! Mistake-proof self-centering workholder sets to size instantly! It saves trouble—lead screw won't jam, it kicks out automatically when standard length thread is cut. Clean perfect threads, *fast!* For trouble-free extra-easy pipe threading buy 65R at your Supply House.

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

RIDGID

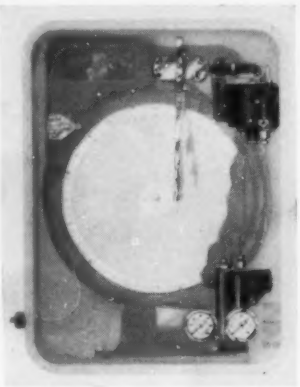
Work-Saver Pipe Tools

More EQUIPMENT NEWS

Begins on page 162

static steam regulator element. Manufacturer claims that perfect functioning of unit results from installation of special thermostatic element and temperature adjustment designed and constructed to close a direct-acting valve or open a reverse-acting valve when thermostatic element is accidentally damaged or loses its charge. Full operation and construction details available on request.

Lawler Automatic Controls, Inc, 453 N MacQuesten Pkwy, Mt Vernon, N. Y.

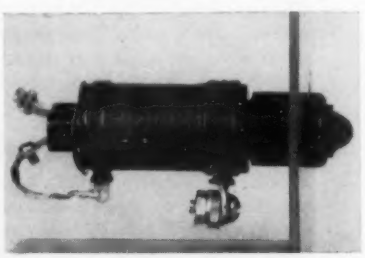


Signal Transmitter

441 • Widely-known ring balance meter is now available with specially designed pneumatic signal transmitter. This makes the instrument readily adaptable to wide variety of remote metering and control applications, including control installations requiring reset, remote adjustable set-point and rate action. Available maximum signal pressure ranges are 15, 30 and 60 psi. Change from one signal range to another requires only substitution of proper calibrating spring. Minimum signal pressure may be substantially zero, or may be suppressed to 3 or 5 psi. Output from transmitter can be used to actuate receiver type indicating, integrating or recording instruments or as the actuating signal for an automatic control system. Full construction and application details are available on request to manufacturer.

Hagan Corp, Pittsburgh, Pennsylvania

For more data on these items, use post cards p 171. Identify your request with item number.



Indicating Lamp

444 • New all-molded indicating lamp for switchboard steel panels features compound-color caps that are specially treated

(Advertisement)

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 2 APRIL 1954 Number 2

Long-Standing Boiler Sludge Problem Cleared Up

A manufacturer in Western Pennsylvania found the remedy for frequent acid cleaning of low pressure boilers when Hall sales engineer, L. C. Bishop, called on him to discuss the problem of sticky sludge. From the analysis of the feed water and a deposit from the boiler, Bishop recognized that the long-standing difficulty with sticky sludge was due to silica deficiency.

Until Hall was put on the job, alkalinity control and phosphate residuals had been adequate, but an attempt to eliminate the sticky sludge by use of a dispersive had not produced the desired results. Hall service engineer B. Q. Welder instituted treatment with silicate to overcome the silica deficiency. One month later an inspection showed that build up of deposit on the boiler surfaces had been reduced. Accumulations which had not been removed by an acid cleaning job just prior to starting Hall treatment were now being removed by the silicate feed.

The operators found the boiler cleaner than it had ever been. To quote the foreman, "We can see surfaces of the shell that we haven't seen for ten years."

Analytical Chemistry and Spectroscopy Conference

The fifth annual Conference on Analytical Chemistry and Applied Spectroscopy was held in Pittsburgh, March 1st through 5th, by the Analytical Chemistry Group, Pittsburgh Section, ACS, and the Spectroscopy Society of Pittsburgh. R. K. Scott of Hall Laboratories was co-chairman of the Conference-Exposition committees.

The program included sessions in which papers on new developments in analytical chemistry and spectroscopy were presented.

Hagan Corporation displayed Hall Certified Reagents and related equipment, and the new Calgon Speedy-Kit for testing water hardness.

American Power Conference

Sponsored by the Illinois Institute of Technology with the cooperation of a number of universities and technical societies, the American Power Conference was held in Chicago, March 24, 25 and 26. The Conference featured a Diamond Jubilee Dinner celebrating the 75th anniversary of the invention of electric light.

Four sessions of the Conference were devoted to water technology. In one, a paper, "Boilers and Boiler Waters—Interlocking Advances in Design," by H. M. Rivers and S. B. Osborne, was presented by Mr. Osborne, Staff Engineer of Hall Laboratories.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Thorough Study Solves Boiler Problem

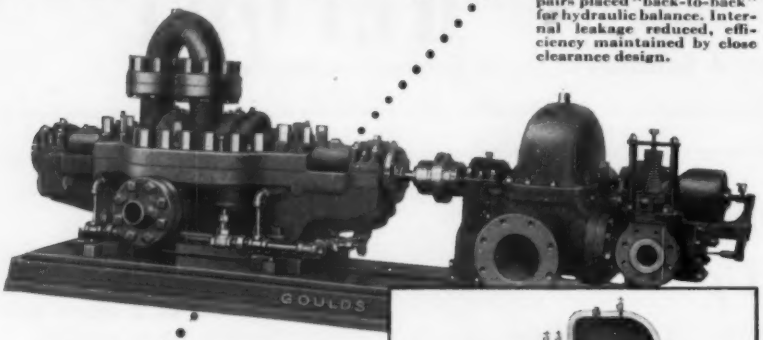
On the basis of a single and inaccurate raw water analysis, a manufacturing plant in the midwest installed a sodium cycle softener. Only when construction was finished was Hall Laboratories called in. The Hall engineers, in starting up the boilers, advised the plant engineers that the pretreatment equipment was not suitable for their particular conditions. However, since the boilers were ready to go on the line, it was decided to try to operate. Then real trouble set in.

Contrary to the original analysis, the raw make-up water had a high bicarbonate content, so that the sodium cycle softening resulted in extremely high boiler-water alkalinity. Carryover and the necessity for excessive blowdown were only the beginning of the problems involved. Serious corrosion in the condensate piping occurred because of high carbon dioxide in the steam.

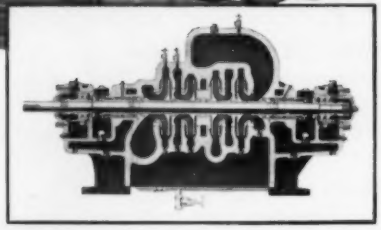
At this point it was evident that a complete study of the water problems had to be made if satisfactory conditions were to be established. Beginning with analyses of the plant water and carrying through to recommendations for the best equipment to prepare the water for its intended use, Hall headquarters engineer L. Highley considered all the existing factors in making the survey. Revamping of the entire pretreatment setup to provide dealkalization is now under way.

A survey prior to plant construction could have provided for the right equipment to do an efficient job at a cost far lower than the outlay entailed in the revision of the initial setup.

Keep Efficiency Up—

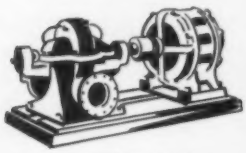


GOULDS Fig. 3360
Single-suction impellers in pairs placed "back-to-back" for hydraulic balance. Internal leakage reduced, efficiency maintained by close clearance design.



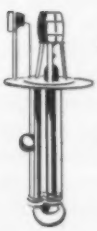
Costs down
with *Goulds*
High Pressure Centrifugal Pumps

Other GOULDS Pumps for Heavy-Duty Service



GOULDS Fig. 3450
These double-suction, single-stage Goulds centrifugals will handle up to 15,000 G.P.M. Heads up to 500 ft. Bulletin 721.2.

GOULDS Fig. 3705
Stainless steel pumps for handling acid and alkaline liquors. Capacities up to 600 G.P.M. Heads up to 160 ft.



GOULDS Fig. 3047
Nonclogging impeller of this vertical sump pump will handle water containing large solids or fibrous materials.

In power plant boiler feed service or other installations where high pressures and temperatures are encountered, it will pay you to specify Goulds High Pressure Centrifugal Pumps.

Low in cost and easy to install, they assure real economy. Goulds save you money while in operation, too. Their simple, durable construction provides years of 24-hour-a-day trouble-free service . . . means lower replacement costs and reduced maintenance for you.

The Goulds Fig. 3360, pictured above, is available in bronze fitted construction with heavy-duty, double ball bearings, in sizes 3″ to 8″, stages 2 to 8, capacities to 2250 G.P.M. Heads to 3050 ft. Bulletin 722.5 contains details and specifications. Write for it today.

MEMBER

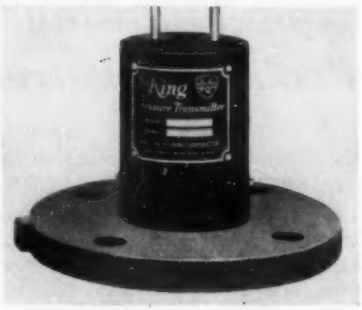
Goulds PUMPS INC.
Seneca Falls
New York

More EQUIPMENT NEWS

Begins on page 162

to increase glow. Series resistor provides long life expectancy, and standard 24E telephone lamp with slide base allows easy changing of bulbs. Available in six colors and for panels up to ¼-in. thick, lamp is approximately ½ in. shorter than previous indicating lamps.

General Electric Co, Schenectady 5, New York



Pressure Transmitter

423 • *Model 6100F* pressure transmitter, for use with pneumatically-operated instruments, measures pressure of liquids and gas and depth, weight or volume of liquids in vented and pressurized tanks. Unit provides positive seal between gaging system and fluid so that it can be used with liquids that otherwise would be dangerous or difficult to measure. This is essentially a 1-1 transmitter, has linear response from ½-in water upward. It withstands overpressures of 250 psi without damage. Full details available in manufacturer's catalog 4000.

King Engrg Corp, Ann Arbor, Michigan

For more data on these items, use post cards p 171. Identify your request with item number.

Timing Device

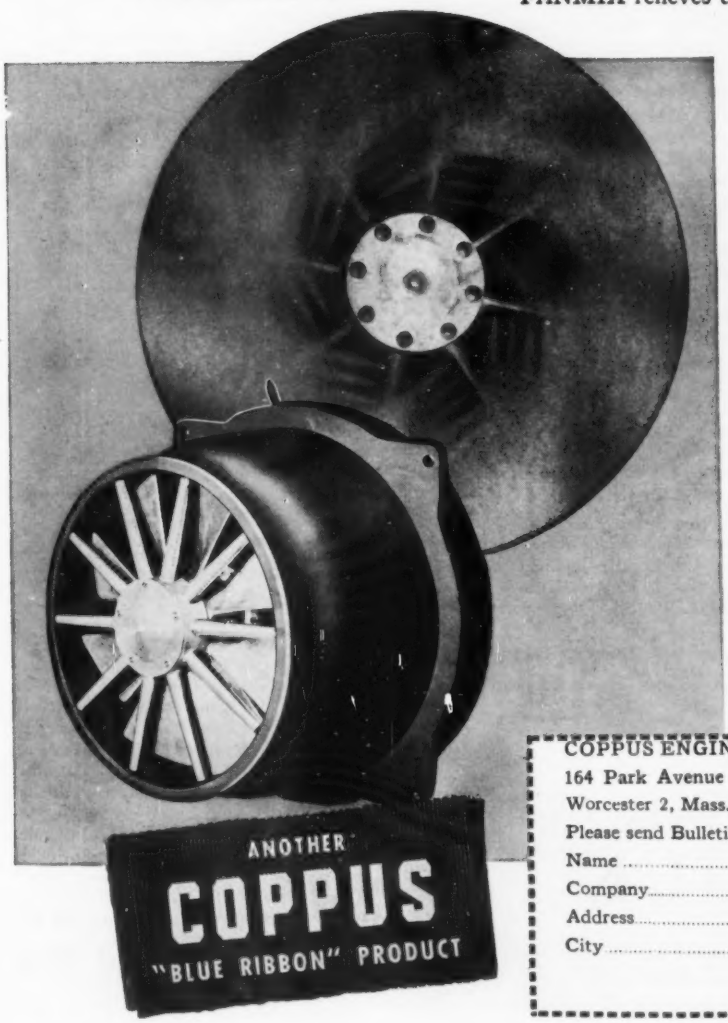
440 • New timer gives servicemen positive proof of total running time and total elapsed time of any unit under test. Unit is manufactured in two standard models: 115 v 60 cycle for use on domestic refrigeration and small commercial units using compressors of ¾ hp or less, and 230 v 60 cycle model for use on large commercial installations using 230 v equipment. Illustrated catalog sheet containing full details may be obtained by writing manufacturer.

Jas P Marsh Corp, Skokie, Illinois

Hydraulic Operator

460 • Simplified hydraulic-operating mechanism coupled with mechanical trip-free linkage increases performance demands of power circuit breakers. New mechanism stems from wartime development of bladder-type pneumo-hydraulic accumulator for energy storage and constant viscosity oil for all-weather operation. Life test con-

You get MORE CAPACITY with a FANMIX BURNER



Increase Boiler Ratings On Present Or Planned Equipment

In all types of Coppus-Dennis FANMIX Burners — straight gas or combination gas-oil — we utilize the energy of the fuel under pressure to drive the burner fan and deliver air in the proper proportion to the fuel flow. This exclusive "pinwheel action" *mechanically* mixes fuel and air in exactly the right proportions for truly radiant, non-luminous heat.

The result is uniform temperature everywhere in the combustion chamber — no drifting "hot spots" — and complete combustion under all conditions. That's why you can release more heat into your present furnace — why in new installations you get more heat into smaller furnace space.

FANMIX Saves On Both Old and New Installations

FANMIX can easily be operated with your present furnace and stack, requiring only minor changes in other equipment. Or if you're planning on new boilers, remember that FANMIX relieves the furnace from the burden of mixing, creates its own forced draft and takes smaller pipe sizes. Which means you can plan on reduced combustion space, less stack, no forced draft equipment and lower installation costs all around.

Get the Whole Story

Coppus engineers FANMIX Burners to meet individual requirements, providing complete control over heat pattern and combustion . . . Learn more about how "pinwheel action" can step up *your* boiler performance to peak efficiency and economy — as it is doing throughout industry. Send for Bulletin 410-6. Coppus Engineering Corp., Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG, and MINING CATALOGS.

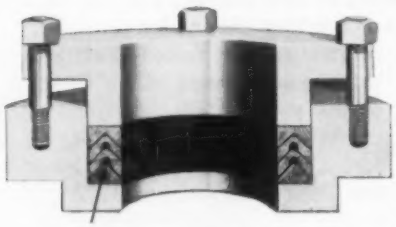
COPPUS ENGINEERING CORPORATION
164 Park Avenue
Worcester 2, Mass.
Please send Bulletin 410-6 to:
Name .....
Company .....
Address .....
City ..... Zone ..... State .....

Why users prefer

CHEVRON* Packing

for rams, plungers, reciprocating rods

1. *Assures a low friction, positive seal*
2. *Lasts much longer, needs less maintenance than ordinary V-type packing*
3. *Works efficiently in a shallow stuffing box*



Note the exclusive hinge-like construction of CHEVRON packing.

Garlock 431 CHEVRON Packing

GARLOCK CHEVRON Packing is entirely different from ordinary V-type packings. With *increasing* pressures CHEVRON rings tighten and prevent leakage; with *decreasing* pressures the packing eases off and permits operation with a minimum of friction.

Service reports, such as those below, prove that CHEVRON packing seals better and lasts longer.

▶ On hydraulic press—40″ ram, 6,000 p.s.i., ram honed and chrome plated, gland machined to give clearance of .006″ between gland and ram. Garlock 431 CHEVRON size 40″ x 41½″ x only 2″ deep gave 14 years service.

▶ On a machine with hydraulically operated clutches—¾″ cylinder, maximum pressure 500 p.s.i., service intermittent, maximum travel ¾″. First used cups, then "O" rings, neither of which worked well. Now packed with Garlock 431 CHEVRON ⅜″ x ¾″ x 11/32″ deep and doing a smooth, positive sealing job.

Ask your Garlock representative to give you all the cost-saving facts about CHEVRON packing, or write for folder AD-115.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia Pittsburgh • Portland (Ore.) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

*Registered Trademark

GARLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS

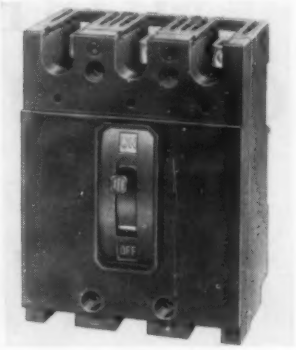
RUBBER EXPANSION JOINTS

More EQUIPMENT NEWS

Begins on page 162

sisting of 6000 closing and reclosing operations of system's complete operating mechanism, including controls, revealed no changes in operating characteristics. Full details of design and operation available.

Allis-Chalmers Mfg Co, Milwaukee 1, Wisconsin

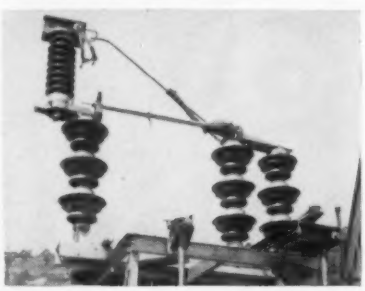


Circuit Breaker

438 • With completely new design in 1, 2 and 3-pole construction, *I-T-E "E"* frame circuit breaker can be used in panel board, switchboards, load centers and all types of individual enclosures. Unit is available in ratings from 15 to 100 a; 1 pole: 125 v ac-dc; 2 and 3 pole: 250 v ac, 125/250 v dc; 5000 a interrupting. Further details available on request to manufacturer.

I-T-E Circuit Breaker Co, 19th & Hamilton, Philadelphia 30, Pa.

For more data on these items, use post cards p 171. Identify your request with item number.



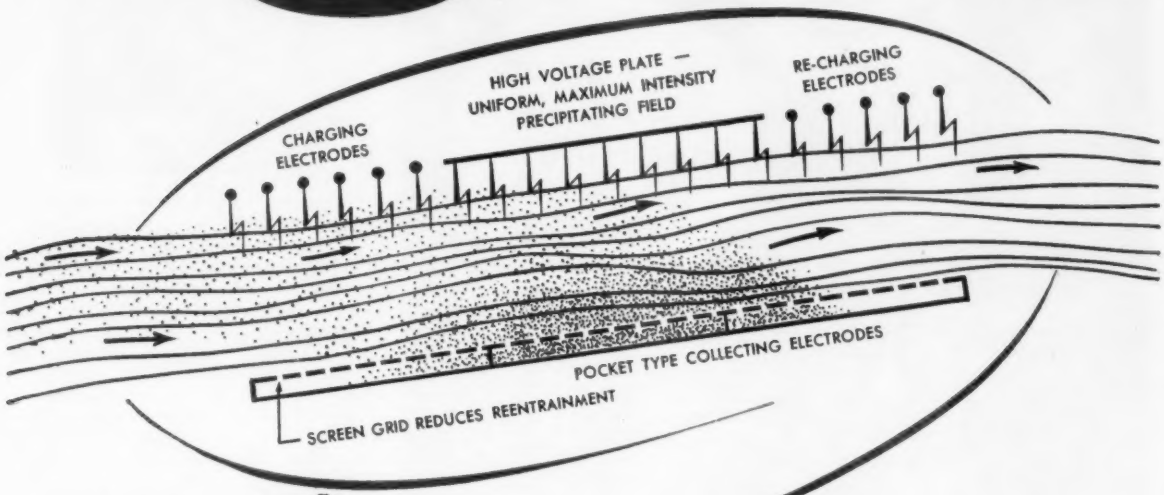
Load Interrupter Switch

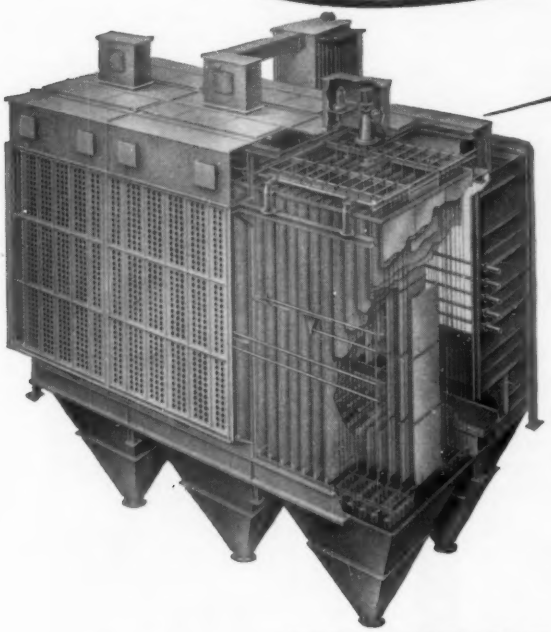
445 • New load interrupter switch, *Type VLB*, for line sectionalizing and load switching combines functions of circuit interrupter and disconnecting switch. It will interrupt transformer magnetizing currents, line-charging currents and load currents up to continuous rating of switch. Gas-filled interrupter is a parallel-connected unit that carries current only during interrupting interval. It is porcelain-clad, gas-sealed, and requires no external supply of gas or other auxiliary apparatus for operation. Switch is available in voltages from 7.5 to 115 kv with a continuous current rating of 400 and 600 a. Further information available.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pennsylvania

(*Continued on page* 186)

The reasons for High Efficiency with AEROTEC Electrical Precipitators


HIGH VOLTAGE PLATE — UNIFORM, MAXIMUM INTENSITY PRECIPITATING FIELD
CHARGING ELECTRODES
RE-CHARGING ELECTRODES
POCKET TYPE COLLECTING ELECTRODES
SCREEN GRID REDUCES REENTRAINMENT



Exclusive design of the charging and collecting electrodes is the principal reason why Aerotec Electrical Precipitators assure higher precipitation efficiency and retention of dust particles.

In the first zone of the unit, six high-voltage wires charge the dust. A flat high-voltage plate provides an area of maximum field intensity in the second zone, and forces the charged particles toward the collecting electrode. This high-voltage plate reduces power input, as it is not a discharge element, and results in a maximum, *uniform* precipitating force.

The collecting electrodes are of a pocket-type design. They provide a recessed, comparatively quiet section for retaining the dust. Aerotec collecting electrodes are composed of a flat plate, vertical baffles, and a screen grid that acts both as a mechanical and electrical barrier.

Particles or agglomerates are not exposed to the direct scouring action of the gas stream and are therefore less likely to be reentrained.

The pocket-type electrode further reduces reentrainment as the vertical baffles and screens form channels through which dust falls to storage hoppers. The Aerotec design utilizes continuous short interval rapping. Heavy build-up on the collecting electrodes is thus eliminated, resulting in a consistently clean stack.

The Thermix Corporation, Project Engineers for the Aerotec Corporation, will be glad to help you in the solution of your dust problem. Why not contact them for further details on this highly efficient method.

Project Engineers **THE THERMIX CORPORATION** Greenwich, Conn.

(Offices in 38 Principal Cities)

Canadian Affiliates: **T. C. CHOWN, Ltd., Montreal 25, Quebec; Toronto 5, Ontario**

Manufacturers

THE AEROTEC CORPORATION

GREENWICH, CONN.

DEIONIZED WATER

...a pint, for a steam iron

...or 2,000 gallons per minute, for steam boilers

with Nalcite® (DOWEX*) ION EXCHANGE RESINS

From the small jobs of providing pure water for home steam irons to the big ones of producing silica-free deionized water at 2,000 gallons per minute for large steam generators, Nalcite Cation and Anion Exchange Resins perform with a dependability and efficiency that command confidence throughout the industry.

Facts on Nalcite HCR Cation Exchange and Nalcite SAR and Nalcite SBR Anion Exchange Resins are yours for the asking. Write today for bulletins 57, 58, and 60.

*Registered Trademark of the Dow Chemical Company

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario

Nalco PRODUCTS

When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

More EQUIPMENT NEWS

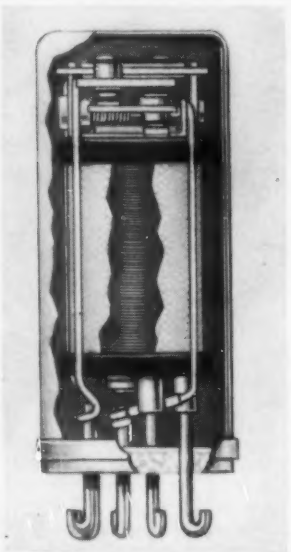
Begins on page 162

New Switchboard Design

439 • New line of switchboards for low voltage distribution applications feature several advantages: isolated wiring trough provides ample space for laying conductors, two drop-off openings per section assure neater and safer wiring; higher short-circuit capacity of main bus bars results from edgewise mounting in unique clamping arrangement; more compact construction and reserve space for future circuits and flexibility of circuit arrangement. Further information available on request to manufacturer.

Square D Co, 6060 Rivard St, Detroit 11, Michigan

For more data on these items, use post cards p 171. Identify your request with item number.

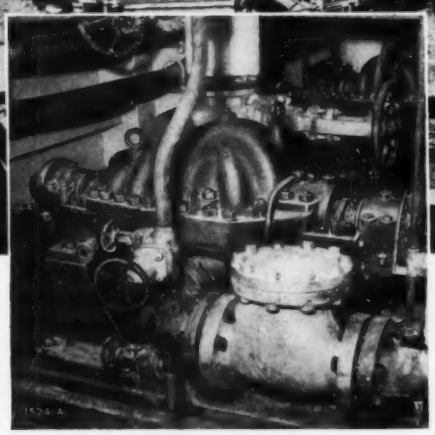


Hermetically-sealed Relay

448 • New miniature dc-actuated hermetically-sealed relay features rugged balance-armature construction that withstands 10G vibration up to 500 cps during operation. Needle-point pivot bearings afford friction-free movement and extremely long

DE LAVAL OPPELLER PUMPS

are used for boiler feed on floating process plant



Three De Laval Oppeller Boiler Feed Pumps play an important role in the Freeport Sulphur Company's new process which mines sulphur from a deposit beneath the Gulf of Mexico. This floating plant is located in the marshes in Bay Ste. Elaine, Louisiana.

The De Laval Boiler Feed Pumps operate at 3,500 rpm with water heated to 297F. They are built with 12% chrome steel impellers and trim. The dependable performance of these units has led Freeport Sulphur to purchase six additional pumps for boiler feed service at two other mines. In addition to boiler feed, De Laval Oppeller Pumps are used throughout industry for mine dewatering, descaling, desuperheater feed as well as for services in the petroleum, pipeline and marine fields. Capacities range up to 2,000 gpm, pressures to 1,200 psig, temperatures to 350F; materials to suit any service. For complete data, send for Catalog 1502.

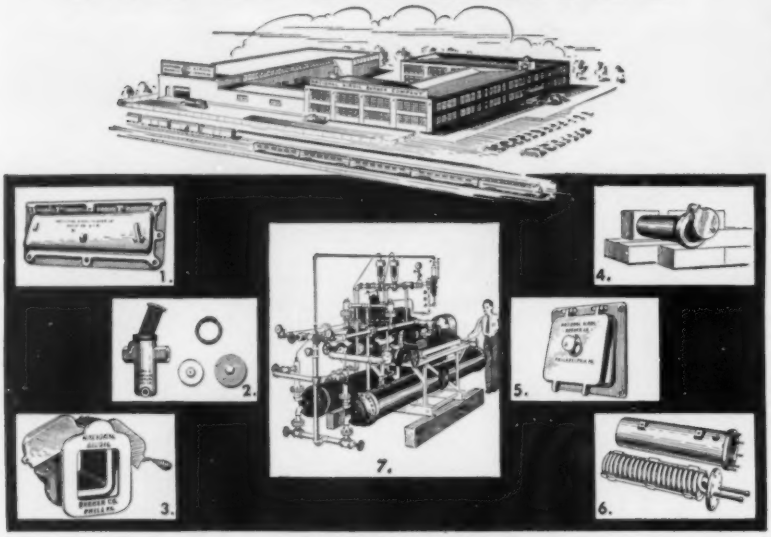
DE LAVAL *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL-200

A Complete Line of
COMBUSTION
ACCESSORIES



for EVERY
INDUSTRIAL LIQUID FUEL-GAS INSTALLATION

1. Air Control Door and Frame, top hinged, ratchet type, heavy duty, for manual control. Surfaces are machined to a close fit.
2. Fuel Oil Suction Strainer, single type. Large basket area insures low pressure drop; cover and basket easily removed for cleaning.
3. Wide-View Peephole, safety, curtain type. Cobalt glass removed to show bearing surface for curtain. Curtain halves are interlocked—open simultaneously.
4. Ignition Port with Refractory Tile No. M896 . . . for use with standard 3" pipe. Also serves as a peephole.
5. Furnace Relief and Access Door, heavy construction, practically air tight. Door casting correctly weighted, lined with plastic refractory retained by imbedded grill; with observation port and cover.
6. Fuel Oil Heater, Self-Cleaning, Spiral Coil type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.
7. Fuel Oil Pumping and Heating Unit . . . Twin or Single Pumps, Steam driven, Electric driven or combination Steam-Electric, with Single or Double Fuel Oil Heaters and accessories for feeding oil at constant pressure and temperature.

. . . yes, just as we are proud of supplying the *right* liquid fuel or gas burning equipment (over 41 years experience throughout industry), so, also, are we proud of our full line of highest quality accessories to supplement your every combustion need. Within our modern, "daylight" factory, salesrooms and general offices NATIONAL AIROIL likes and adheres to the phrase, "nothing but the best"! We believe that our record speaks for itself . . . i.e.; the "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil and Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation.

May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

Ask for Brochure No. 10

NATIONAL AIROIL BURNER

NATIONAL AIROIL BURNER CO., INC.

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More EQUIPMENT NEWS

Begins on page 162

life. High permeability, low residual nickel-iron magnetic structure provides high sensitivity previously unobtainable in relay of this size. Further details available.

Potter & Brumfield, Princeton, Ind.

Rectifier-type Welder

436 • New 400-a, 3-phase, dc, rectifier-type welder with 60% duty cycle can be equipped to operate on 2-phase power, has current welding range of 70 to 500 a. It can be utilized with variety of electrode sizes for repair, maintenance and construction work. Selenium rectifier welder makes it easy for operators to achieve current adjustments by means of stepless current control. Reversible, 14-in. forced-draft fan, rated for continuous service, provides proper ventilation and prevents hot spots. Unit operates on 220/440 v reconnectable to either voltage; weighs 660 lb.

General Electric Co, Schenectady 5, New York

For more data on these items, use post cards p 171. Identify your request with item number.

Welding Rods

462 • New specially-coated welding rods for both carbon arc and torch-welding of aluminum feature following advantages: increased speed of application without sacrifice of physical properties; sound, porosity-free welds of good appearance; less distortion of work; flexibility in choice of arc or torch. Diameters are 3/32, 1/8, 5/32 and 3/16 in; length in all sizes is 28 in.

All-State Welding Alloys Co, Inc, 249-55 Ferris Ave, White Plains, N. Y.

Welding Goggles

410 • New *Model 492 SV Stac-Vent* goggle for welding combines greater comfort

(*Continued on page* 192)

Remember the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS.

Engineered for endurance

THE TUBE-TURN Welding Neck Flange is the preferred choice for most severe piping services—resulting from high pressures, temperature extremes, or numerous fluctuations of substantial amount in either temperature or pressure or both. Due to its long-tapered hub which affords a smooth transition in thickness, the welding neck flange assembly has an endurance strength equal to that of pipe joined by butt welds.

You can fill all your requirements for Welding Fittings and Flanges from TUBE TURNS' complete line. For prompt, efficient service, call your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

The Leading Manufacturer of Welded Fittings and Flanges

TUBE TURNS

LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

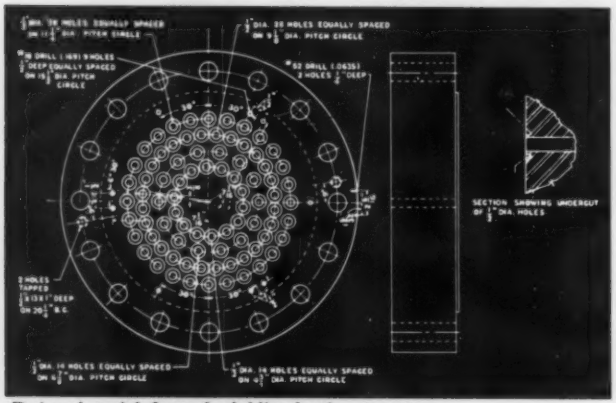
DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Chicago • Denver • Los Angeles
San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

ENGINEERING SERVICE

YOUR NEEDS *in welding fittings and flanges are met efficiently and quickly by your nearby* TUBE TURNS' *Distributor. There are more than 4000 items in the complete line of* TUBE TURNS' *products. Example: carbon steel elbows from ½" to 42" diameter as shown.*

SIMPLIFIES JOB. *The uniform wall thickness and true circularity of* TUBE-TURN *Welding Elbows makes possible accurate fit-up when cut to odd angles for jobs such as the 16" gas line shown.*

Your problems solved by TUBE TURNS' ENGINEERING SERVICE



Design of special flange for holding heating elements.

MOST FLANGE NEEDS in industrial piping are filled by TUBE TURNS' ASA line of various types, sizes and materials. However, there are many exceptions . . ."specials" such as these: (1) lens ring flanges for use at 5300 psig and 400°F, with test pressure of 10,600 psig; (2) flanges in sizes from 14" through 72" for use at 30 psig and 400°F max.; (3) 2" flanges for high vacuum service at 400°F—950°F, and (4) various complex sheet tube flanges.

A "special" example is shown at the left, developed by TUBE TURNS' Engineering Service Division for E. L. Wiegand Co., Pittsburgh. It has 84 holes for heating elements. Flanges must withstand hydrogen-nitrogen mixture at 1000 psig at 750°F and 3000 psig at atmospheric temperature.

TUBE TURNS IS AT YOUR SERVICE!

DISTRICT OFFICES

New York	Midland
Philadelphia	Tulsa
Pittsburgh	San Francisco
Cleveland	Los Angeles
Chicago	Seattle
Houston	Atlanta
Dallas	Denver

"tt" and "TUBE-TURN" Reg. U. S. Pat. Off.

Want Dimension Data?

TUBE TURNS has compiled a handy folder of charts covering dimensions and weights of TUBE-TURN Welding Fittings and Flanges. If you'd like a free copy just send this coupon.

TUBE TURNS, Dept. C-2
224 East Broadway, Louisville 1, Kentucky

Company name _____

Company address _____

City _____ *Zone* ____ *State* _____

Your Name _____

Position _____

TUBE TURNS

LOUISVILLE 1, KENTUCKY

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

We call it...

Raw Water #628

It's really Mississippi River water. An oil refinery uses it for boiler feed and for process water.

We worked on #628 . . . on the whole problem of this refinery's water requirements.

As it came from the river #628 obviously could not be used. It was so full of dirt it looked like *café au lait.* Treated now through Graver equipment, it is completely safe for delicate, high pressure boilers.

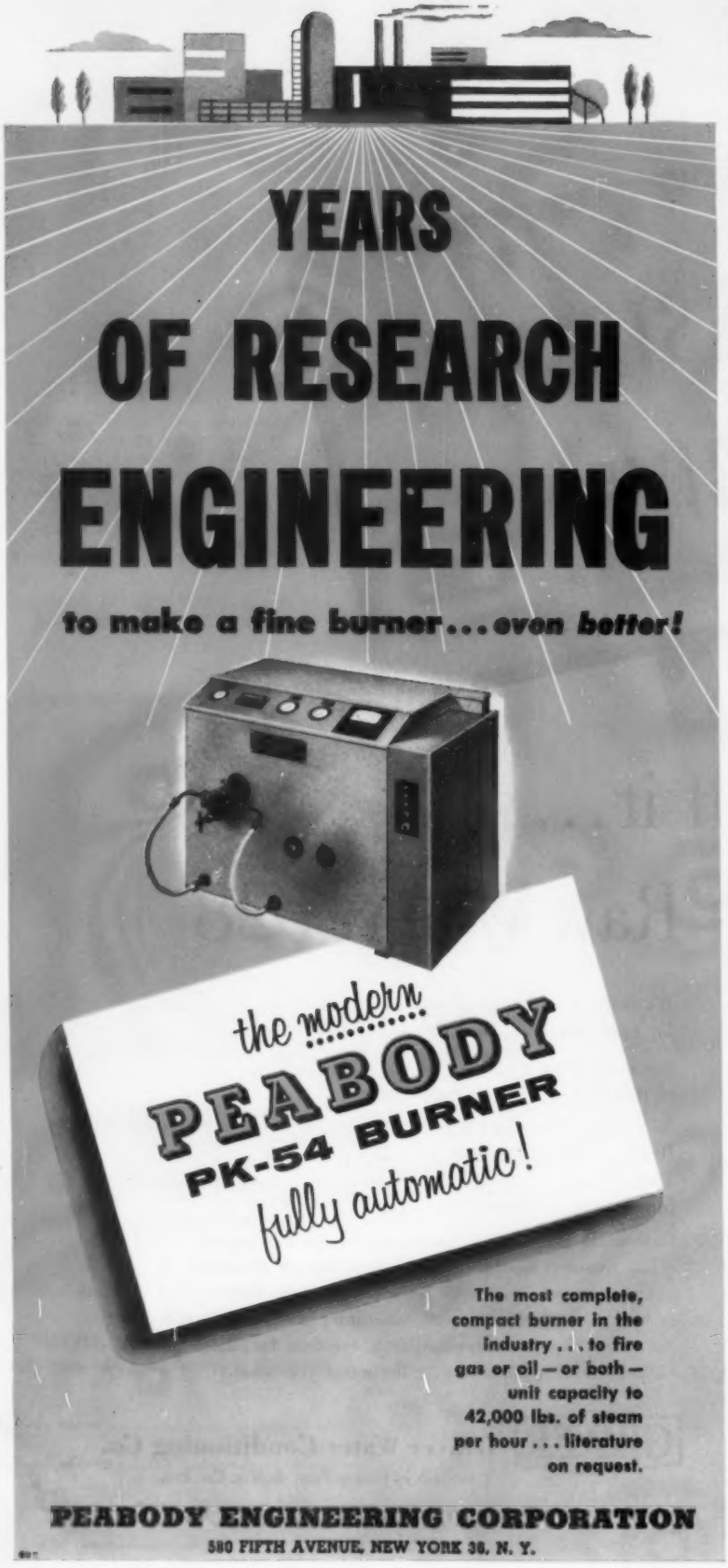
Raw water #628 could have been useless for any of several other reasons: hardness, silica, bicarbonate alkalinity or oxygen content. No matter what the problem, Graver is in business to help you solve it . . . with laboratory and pilot plant testing, equipment design, manufacturing, erection facilities, and anything else it takes to give the water you want.

GRAVER **Graver Water Conditioning Co.**

A Division of Graver Tank & Mfg. Co., Inc.

216 West 14th St., New York 11, N. Y.

• *Go to Graver for Water Conditioning*


YEARS
OF RESEARCH
ENGINEERING
to make a fine burner... even better!
the modern
PEABODY
PK-54 BURNER
fully automatic!
The most complete, compact burner in the industry . . . to fire gas or oil — or both — unit capacity to 42,000 lbs. of steam per hour . . . literature on request.
PEABODY ENGINEERING CORPORATION
580 FIFTH AVENUE, NEW YORK 36, N. Y.

More EQUIPMENT NEWS

Begins on page 162

with lower cost protection. New principle of goggle ventilation prevents fogging by providing draft-ventilation at top and center of goggle where warm moist air normally accumulates. Units feature interchangeability of lenses. Opaque black soft vinyl plastic frame, large enough to fit over all prescription glasses, form-fits contours of face and nose. Full details available on request to manufacturer.

Watchemoket Optical Co, 232 W Exchange St, Providence, R. I.

Welding Helmet

409 • New plastic welding helmet offers both safety and comfort. Lightweight and strong, helmet has standard ventilation for cooler working and prevention of lens fogging. Seamless plastic shell is heat-resistant, moisture-proof and non-warping. Models are available in durable black finish with or without flip-front.

General Electric Co, Schenectady 5, New York

For more data on these items, use post cards p 171. Identify your request with item number.

Adjustable Bar Hanger

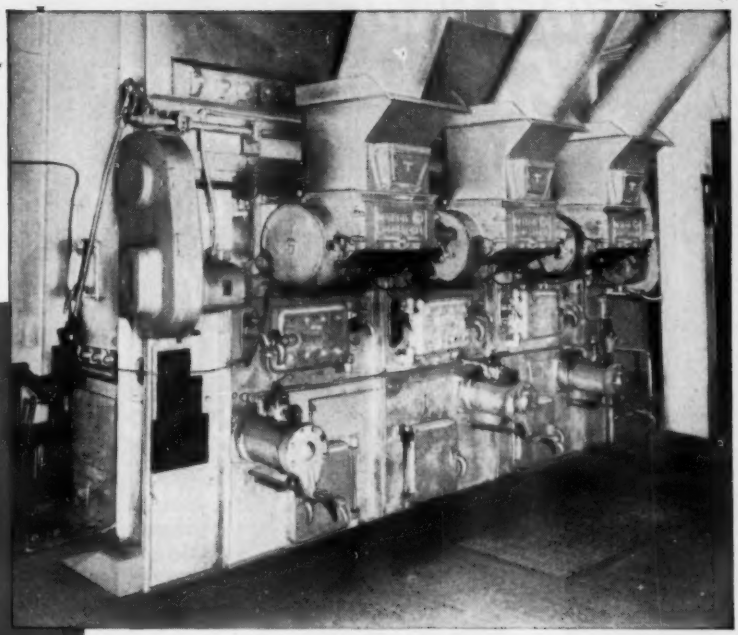
407 • New adjustable bar hanger offers tremendous strength yet has simple telescopic adjusting action found in ordinary curtain rods. Available as clip bars and stud bars, units fit all sizes of furrings and studdings from 1x2 to 2x4 and all sizes of joists and rafters. According to manufacturer, this is the only bar hanger designed to fit modern shallow-wall construction. Further details available on request.

Raco Division, All-Steel Equipment Inc, Aurora, Illinois

Hard-faced Seat Rings

456 • New line of seat rings are precision made from carbon, stainless or tungsten die steels and hard-faced at points of wear and impact with stellite overlays. This provides a wear surface that increases load-carrying capacity and operating life. Rings are available in 1 to 14-in. dia and are furnished to meet specific tolerances.

Size of ring determines depth of hard-facing alloy; it will vary from .060 to .090 in. Applications include all forms of pop-



15%

FUEL SAVING

with a

NEW DETROIT ROTOSTOKER FIRED BOILER

45,000 Pound Per Hour Installation

Smoke Nuisance Eliminated

This installation, at General Mills, Inc., Buffalo, N. Y. plant is typical of Detroit RotoStoker performance. Not only was there a 15% fuel saving—smoke nuisance, long a problem, was eliminated.

Detroit RotoStokers burn economically any Bituminous Coal or Lignite without special preparation. They increase boiler capacity and respond quickly to sudden changes in load. Fuel is fed by efficient Overthrow Rotors. Fine fuel is burned in suspension—coarser fuel on the grates with uniform, but comparatively thin fuel bed.

Hundreds of Detroit RotoStokers are successfully applied to all makes and types of boilers or steam generators.

Do you need more steam at lower cost? If so, investigate the RotoStoker. Write for Catalog.

6215

DETROIT SINCE 1898 STOKERS

DETROIT STOKER COMPANY

General Motors Building · Detroit 2, Michigan

Works at Monroe, Michigan · District Offices in Principal Cities

PANALARM "50" ANNUNCIATOR SYSTEMS

NEW functional flexibility with NEW "instrument-type" construction

PANALARM "50" PLUG-IN UNIT . . . hermetically sealed and most versatile ever developed . . . simply plugs into chassis to expand system . . . no wiring . . . no other connections. Corrosion-proof and suitable for Class I, Div. 2 locations.

Built-in flexibility of PANALARM "50" allows simple change-over to any operating sequence as required by present or future conditions. And, at the same time PANALARM "50" introduces a new instrument-type annunciator construction . . . adding to the long-term dependability of the entire system.

CABINET is substantial gauge steel with sturdy chassis and sub-door arrangement. It is pre-wired ready for installation, yet completely flexible without re-wiring.

PANALARM ANNUNCIATOR SYSTEMS are self-contained with either illuminated name-plates or bullseye visual signals. Both the audible signal and acknowledgment button are common to the entire system.

SEND FOR COMPLETE 40-PAGE MANUAL

Ask for Catalog 100-1

PANALARM

PANALARM PRODUCTS, INC.
6312 North Broadway, Chicago 40, Illinois

Copyright 1953 Panalarm Products, Inc.

More EQUIPMENT NEWS

Begins on page 162

pet-type valve seating requirements as found in high pressure industrial and blow-off valves, internal combustion engines and steam valves. Additional information available from manufacturer.

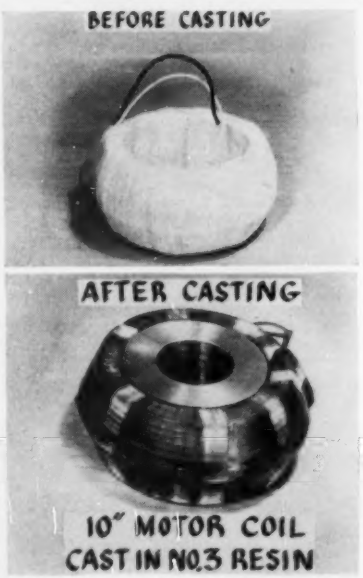
Cleveland Hard Facing Inc, 3047 Stillson Ave, Cleveland, Ohio

Fluted Set Screws

478 • New line of fluted set screws saves time by easily and positively locking on wrench or key. Also, screw is tamper-resistant, since special key is needed to loosen it. Repeated tightening and loosening do not damage screw and it will not split or round out. Full details available.

Set Screw & Mfg Co, 193 Main St, Bartlett, Illinois

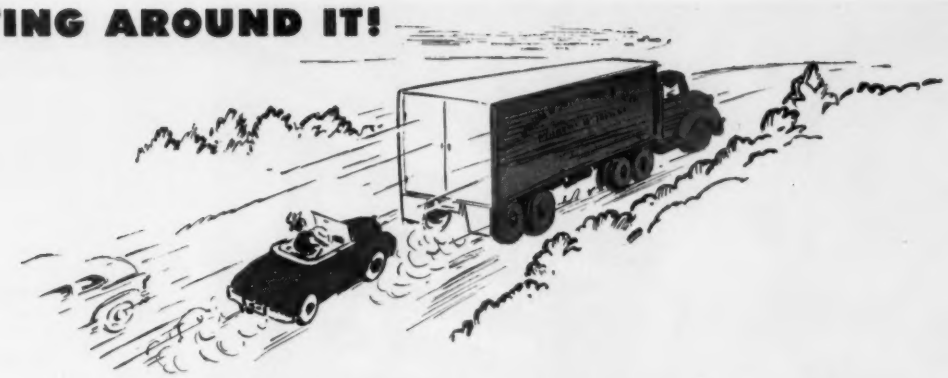
For more data on these items, use post cards p 171. Identify your request with item number.



Electrical Insulation Resin

404 • New epoxy type electrical insulation resin has useable life of from three to five days before setting up. Cure time of this resin that comes in two-part liquid form is from two to four hr at 250 F with longer cure at lower temperatures. Typical applications are embedding resistors, unitized

NO GETTING AROUND IT!

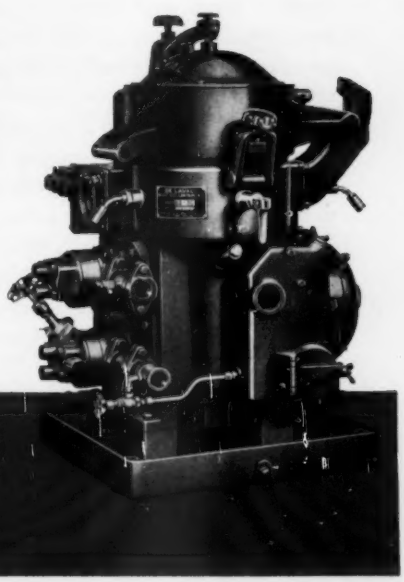


De Laval Turbine Oil Purifiers Prevent Contamination Trouble by Removing the Causes

De Laval Centrifugal Oil Purifiers remove both of the chief causes of lubricating oil deterioration—dirt and water. They are positive insurance that no trouble will occur that can be charged to impure oil.

A De Laval Oil Purifier does a thorough job. Every drop of water is promptly thrown out by centrifugal force and continuously discharged to waste. Dirt is likewise thrown out of the oil and stored outside of the zone where purification takes place.

An important advantage of the De Laval Oil Purifier is the fact that it has enough reserve capacity to take care of a sudden emergency such as a surge of water due to a leak.



THE DE LAVAL SEPARATOR COMPANY
Chicago POUGHKEEPSIE, N.Y. San Francisco

DE LAVAL

FOR MORE DEPENDABLE POWER PRODUCTION

SPECIFY

STRONG "Evrtyte"* VALVES

Here's a block steel valve that has established a reputation for exceptional handling of "the toughest valve job in the plant"—continuous boiler blowdown at pressures up to 1800 psi and temperatures to 800° F.

Advanced design and construction features provide many exclusive advantages in accurate flow regulation under severe conditions—plus an operating life which in some cases has proved to be *ten times* that of other valves used before Evrtyte!

This great valve is equally effective on many other steam and hydraulic "tough" valve applications and it could very well solve your problem where other valves have failed in control service.

Write today for full information or contact your local STRONG distributor.

* REGD. T.M.

STRONG

STRONG, CARLISLE & HAMMOND

1392 WEST 3rd STREET • CLEVELAND 13, OHIO

More EQUIPMENT NEWS

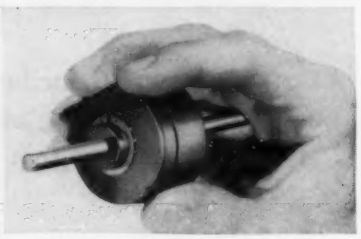
Begins on page 162

electronic circuits, preamps, torroids, and audio and power transformers in solid block of resin to provide trouble-free service under adverse conditions.

Among outstanding features of *Scotchcast* resin No. 3 are its 100% solids nature with minimum shrinkage upon curing, no chemical degradation within operating range of from –65 to 250 F, resistance to corrosives and excellent adhesive properties. Electrical characteristics include: dielectric strength of 1000 to 1500 vpm on thin sections, low dissipation factor over wide temperature range at frequencies of 60 cycles to 30 megacycles and a stable dielectric constant within this range. Tech Bulletin covering full details available on request to manufacturer.

Minnesota Mining & Manufacturing Co, St Paul 6, Minn.

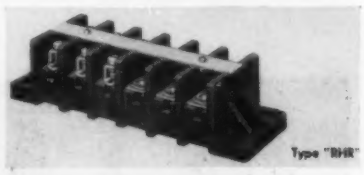
For more data on these items, use post cards p 171. Identify your request with item number.



Electric Brakes, Clutches

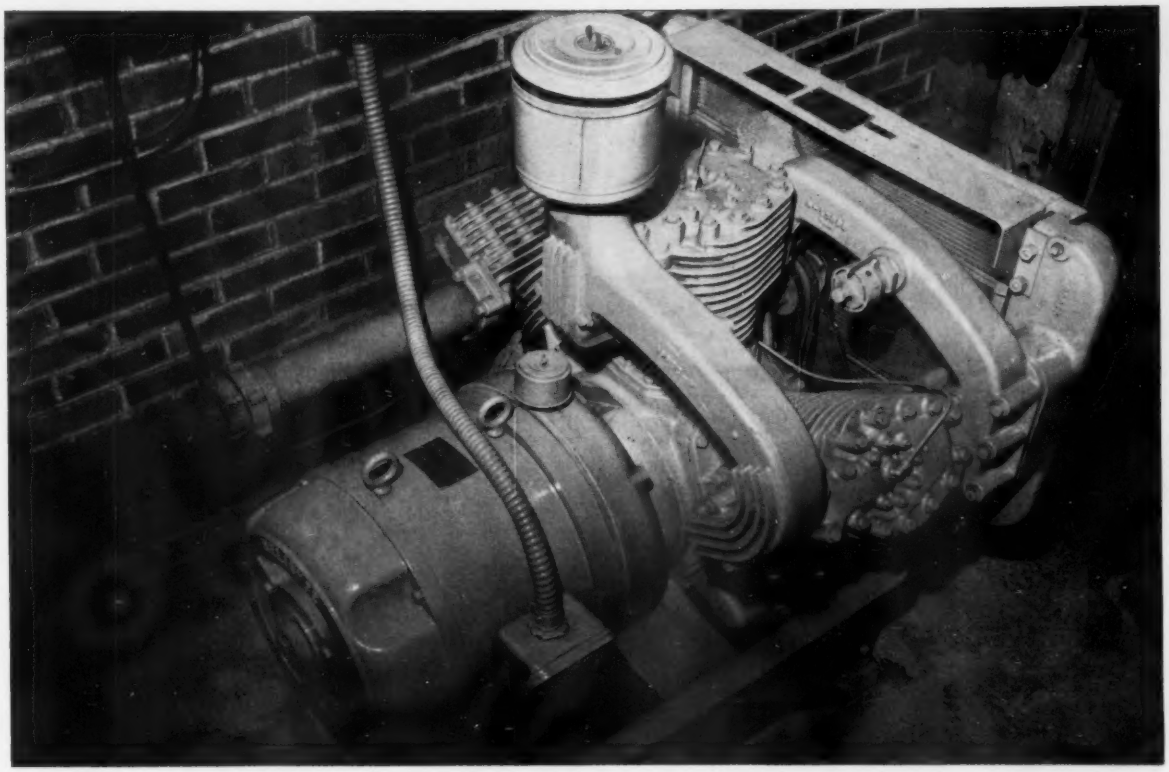
449 • Smaller than a man's hand, these new replaceable-face brakes and stationary field clutches offer several outstanding advantages for wide variety of power transmission applications: high-speed engagement and release, coupled with unusually high torques make the units adaptable to starting, stopping, indexing, rapid cycling, synchronizing, torque limiting, index and jogging and single revolution cycling applications on small electrically operated instruments and machinery. New brakes have just two parts: rotating armature and stationary field with replaceable face. Clutches and clutch couplings have only three working parts: stationary field, rotor and armature. All units operate on 6 to 15 watts dc. Full details available on request to manufacturer.

Warner Electric Brake & Clutch Co, Beloit, Wisconsin



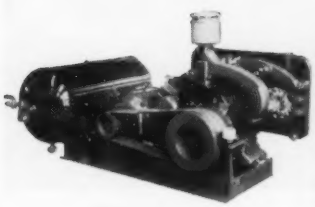
Terminal Blocks

412 • New compact high-current terminal blocks are available in three types: *Type R*—35 a, 750 v with No. 10 brass washerhead terminal screws for wire up to No. 10 AWG; *Type RH*—50 a, 750 v with high-pressure solderless connector for wire from



SAVE ALMOST A MILE EVERY HOUR* IN PISTON WEAR WITH A JOY WL-80 COMPRESSOR—

** Piston speed is lower than that of four comparable compressors. So low that you save over 6½ miles of wear each 8-hour day.*



Joy WL-80 "Packaged Unit" Compressor can be delivered ready-to go, complete with air receivers, piping and wiring.

NEED A SMALL, COMPACT COMPRESSOR as an auxiliary air supply? Or possibly you want a compressor that can be placed right where the air is used and eliminate long runs of piping.

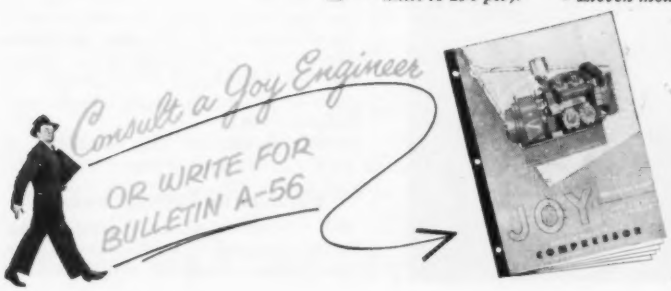
If your requirements call for 640 CFM or less, there's a Joy WL-80 for you:

- *15 to 125 HP.*
- *81 to 641 CFM.*
- *Pressures to 125 psi, standard. (High pressure units to 250 psi).*
- *Single or two stage.*
- *Air cooled.*
- *Force-feed lubrication.*
- *Eleven models.*

. . . And, you have your choice of drives: Direct, V-Belt, Flange-Mounted. In fact, these compressors are available as packaged units, like that shown at the left, delivered complete with air receivers, piping and wiring.

* * *

Get full details by writing for Bulletin A-56. ● **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



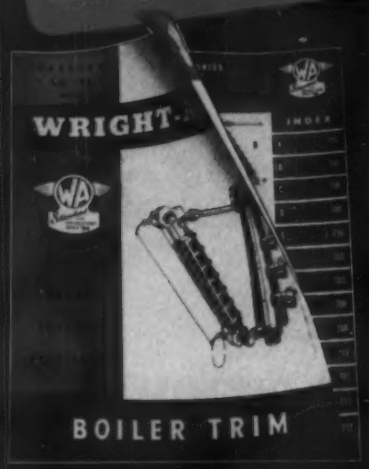
W&D 4942

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

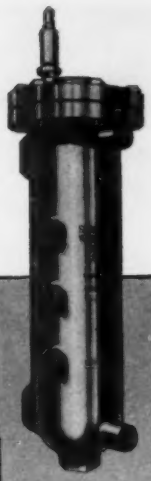
Engineered

FOR SAFER AND MORE EFFICIENT REGULATION OF BOILER WATER LEVEL



new catalog no. 700

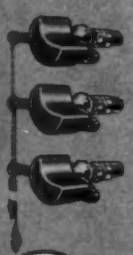
WRITE FOR YOUR COPY TODAY



Safety Alarm Water Columns

Low to High Pressure Gauge Valves

Reflex Gauges for High Pressures



Weighted and Compression Type Trycocks

● For 57 years Wright-Austin has concentrated on the manufacture of highest quality steam specialties. Our familiarity with steam users' requirements assures you of thoroughly practical designs in a complete line of Traps (cat. #600), Separators (cat. #500) and Boiler Trim (cat. #700).

WRIGHT-AUSTIN COMPANY

3245 WIGHT STREET • DETROIT 7, MICH.

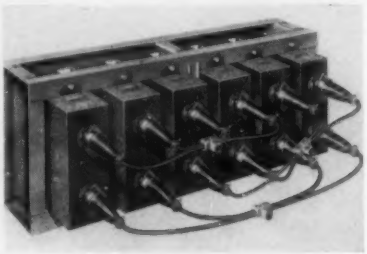
WA Standard and STEAM USERS SINCE '94

More EQUIPMENT NEWS

Begins on page 162

No. 8 to No. 18 AWG; *Type RHR*—any combination of above types in same block. Complete information available on request to manufacturer.

Curtis Development & Mfg Co, 3266 N 33d St, Milwaukee 16, Wis.



Capacitor Equipment

411 • Completely - assembled capacitor equipments ready for installation on secondary-network systems are especially suitable for urban distribution systems where there is air-conditioning and other low pf equipment. Units are standard outdoor type rated at 13 1/3 kvar at 216 v. They are available for 40, 80 and 120 kvar 3-phase. Modular-type construction permits stacking three high or other arrangements to fit available vault space. Further details available on request.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pennsylvania

For more data on these items, use post cards p 171. Identify your request with item number.

Intercom System

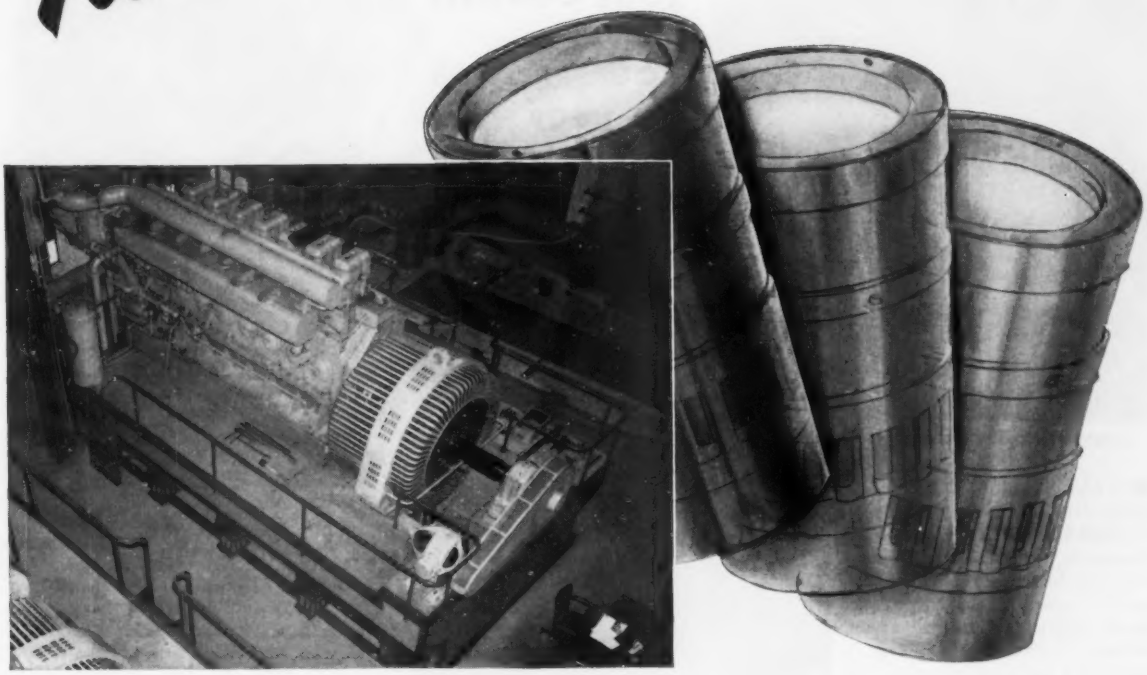
428 • New dial-type intercommunication system features "memory" circuit and device that allows key executives to cut into a busy line with urgent messages. Memory circuit holds calls on busy lines and puts them through, without further dialing, as soon as line is available. Conference systems and direct paging systems are additional features of this new installation. These new intercommunication systems may be either leased or purchased. For complete particulars, ask for manufacturers Bulletin S-100.

Stromberg-Carlson Co, Rochester 3, New York

Furnace and Oven Controls

461 • Complete control packages, individually designed for specific furnace, oven, kiln or dryer applications are now available

Full-Throttle Profit...



Want to open the throttle for more profit? Then throttle back on Diesel operating costs — by using Van der Horst processing.

It gives you a flexible advantage. With VANDERLOY M, we renew worn liners — even those that oversize 0.010 inch per inch of diameter. Finished to original dimensions with PORUS-KROME*, they'll take twice the punishment raw liners can stand.

Yet, as compared to buying new ones, these Van der Horst liners save you money!

Use them to boost the power factor without increase in cost, or take the profit on their higher efficiency and much longer service life — whichever way fits best in your operating pattern.

Diesel owners everywhere find PORUS-KROME out-wears two or more raw liners. Rings stand up proportionately longer, against this unique plated service. And both fuel and lube oil consumption are reduced.

You might as well have this advantage. Cut out the cumulative cost of oversizing and use only standard size parts. Once you've tried it, you'll find Van der Horst processing is the way to full-throttle profit. We'd like to show you, in actual figures.

W53-D6

VAN DER HORST
TRADE MARK

* *PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication.*

U. S. PATENTS
2,048,578, 2,314,604 and 2,412,698

VAN DER HORST CORPORATION • OLEAN, N. Y.

You can have DRY AIR with exact moisture control

ASSEMBLING ELECTRONIC PARTS

FOR YOUR COMFORT
FOR YOUR PROCESS
FOR TESTING MACHINES OR MATERIALS AT ANY TIME OF THE YEAR

PACKAGING FOOD PRODUCTS

● This Niagara "Controlled Humidity" method gives you the **MOST EFFECTIVE** Air Conditioning because its cooling and heating functions are made completely separate from adding or taking away moisture. This assures you always a precise result. No moisture sensitive instruments are needed.

MOST FLEXIBLE. You can reach and hold any condition in response to instrument settings, or vary it as you wish.

EASIEST TO TAKE CARE OF. The machine is accessible, the control circuits are simple and easy to operate, and there are no solids, salts or solutions to be handled.

MOST COMPACT. It does a very large amount of work in a small space.

INEXPENSIVE TO OPERATE. At normal atmospheric temperatures (unlike systems that use refrigeration to dehumidify) it needs no summer re-heat.

DRYING INDUSTRIAL MATERIAL

Write for Bulletins 112 and 122

NIAGARA BLOWER COMPANY

DEPT. P, 405 LEXINGTON AVE. NEW YORK 17, N. Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

More EQUIPMENT NEWS

Begins on page 162

for any specific heating applications. Units include all components necessary for complete installation. Full details available in manufacturer's bulletin P1260.

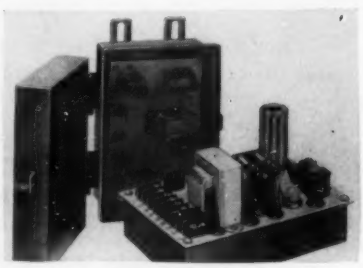
The Bristol Co, Waterbury, Conn.

Substation-size Transformer

442 • New substation-size transformer features new cooling method and reductions in weight and height. Cooling system uses chimney-type radiators instead of numerous tubes. Reduction in number of openings into transformer tank adds to strength and tightness. Unit is available in ratings of 250-kva, high-voltage 15,000 v and below. Other ratings will be available in the future.

General Electric Co, Schenectady 5, New York

For more data on these items, use post cards p 171. Identify your request with item number.



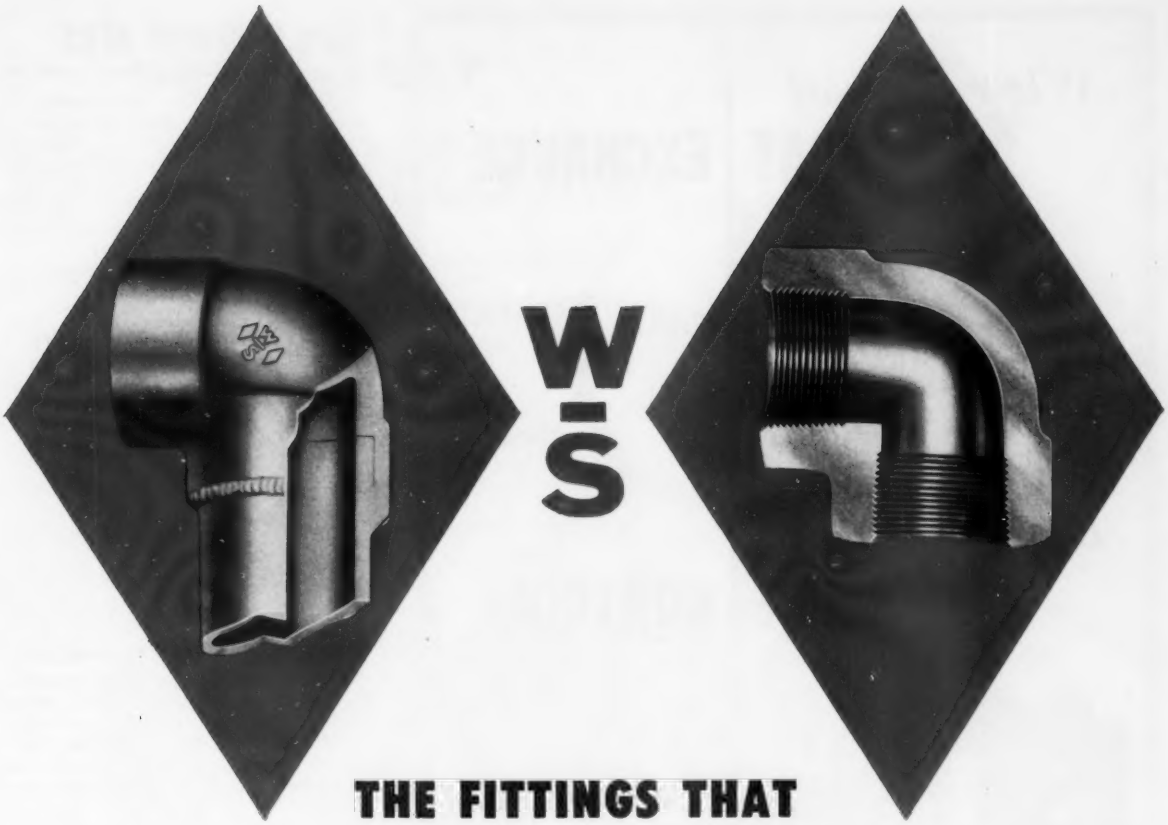
Flow Alarm

433 • New electronic high and/or low flow alarm meets demand for a fail-safe, highly sensitive device for rotameters, manometers and similar processing instruments. Unit offers unequaled range of sensitivity and is the only alarm system that can operate with spherical floats as small as 3/32 in. It will detect 1 mm of float position change. Unit insures that in event of power failure or failure of any electronic component load relay will drop out and operate alarm contacts. Complete specs, operating details and application data available in manufacturer's bulletin No. 165.

Brooks Rotameter Co, Lansdale, Pa.

Power Supply

455 • New model magnetic-amplifier-regulated power supply, MR 1032-50, is rated

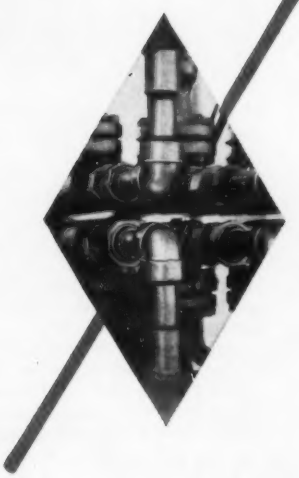


THE FITTINGS THAT CAN REALLY TAKE IT!

Every elbow, tee and cross in a high pressure piping system is a point of concentrated stress. W-S Forged Steel Fittings take this tough service in stride because they're fabricated and designed to resist pressure, heat, shock and vibration. They're drop forged of highest quality steel to produce a dense, tough, forged-fiber structure that can really take it. And careful heat treatment after forging develops the metallurgical properties of the steel to their fullest.

Notice, too, how Watson-Stillman engineers have designed extra strength into the fittings. Long bands extend well beyond the threads or sockets to provide extra reinforcement. Wall thickness is carefully calculated to put extra metal at points of severest stress.

W-S high-precision machining and rigorous inspection follow through to give you the fittings that mean stronger, tougher pipe joints. W-S Forged Steel Fittings are available in both Screw-End and Socket-Welding types in carbon, stainless and alloy steels.



Sold Through Leading Distributors

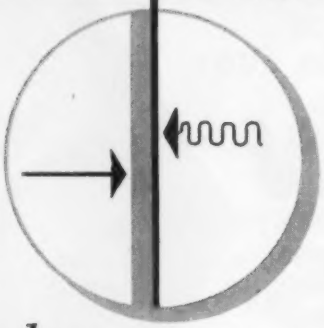
WATSON-STILLMAN FITTINGS DIVISION

H. K. PORTER COMPANY, INC.

Roselle, New Jersey

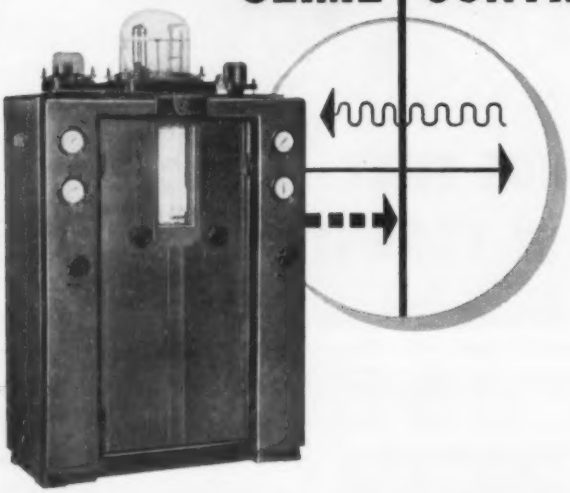
Where you need

HEAT | EXCHANGE



Be sure you have

SLIME | CONTROL



Whether you heat or cool water for make-up, process or any other use, you will need Wallace & Tiernan Chlorination to help combat slime problems introduced by water-borne bacteria or air-borne bacteria.

With slime control equipment designed for any need, built for lasting and dependable service, highly accurate and backed by over 40 years of successful application experience, Wallace & Tiernan Chlorination can help you increase the efficiency of your plant and cut operating costs. For further information write our Industrial Division.

WALLACE & TIERNAN

25 MAIN ST., BELLEVILLE 9, N. J.

CHLORINATORS • CHEMICAL FEEDERS • SCREENING EQUIPMENT • MAGNETIC SEPARATORS • PRECISION PRESSURE INSTRUMENTS • CATHODIC PROTECTION • FINE CHEMICALS

CD-39

More EQUIPMENT NEWS

Begins on page 162

at 10-32 v dc at 50 a continuously with regulation of ±1%. Unique features are: magnetic amplifier regulation is from 0-50 a over dc voltage range of 10-32 v and for ac input voltage range of 220 v ±10%. Ripple is 1% rms max and recovery time is 1 sec. Full descriptive literature available on request to manufacturer.

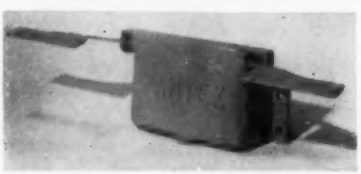
Perkin Engrg Corp, 345 Kansas St, El Segundo, Calif.

Combination Gage-Transmitter

424 • Pressure gage-pneumatic transmitter combines direct indicating with pneumatic transmission for remote indicating, recording or controlling of pressures. Output pressure varies from 3 to 15 lb, 5 to 25 if specified, regardless of range of pressure being measured. Gages are AA Grade in either 6 or 8½-in. sizes with bourdon tubes of wide variety of materials such as bronze beryllium, carbon steel, stainless, monel or nickel. Additional information available from manufacturer.

Penn Industrial Instruments Corp, 4110 Haverford Ave, Phila. 4, Pa.

For more data on these items, use post cards p 171. Identify your request with item number.



Two-lever Control

429 • New two-lever coordination control consists of air valve and two extending levers, all interconnected through linkage that permits valve action only when both levers are operated. By simple modification of latch in control, operating characteristics can be altered to satisfy variety of coordination requirements: simultaneous operation, given sequence operation or any sequence operation. In all cases, both levers must be operated before valve will open. Similar variety of conditions can be prescribed to close valve. Full literature available on request to manufacturer.

Pantex Mfg Corp, 521 Roosevelt Ave, Pawtucket, R. I.

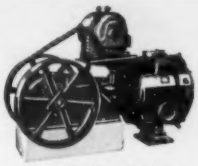
Multi-Purpose Cable

459 • New low-cost versatile cable for branch and feeder circuits, *FlexAll*, is es-

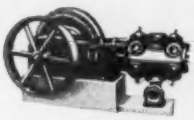
HEAVY-DUTY
"ES" COMPRESSORS

provide maximum efficiency in a WIDE RANGE OF APPLICATIONS

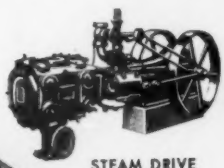
. . . with unusual flexibility of drive and cylinder arrangements



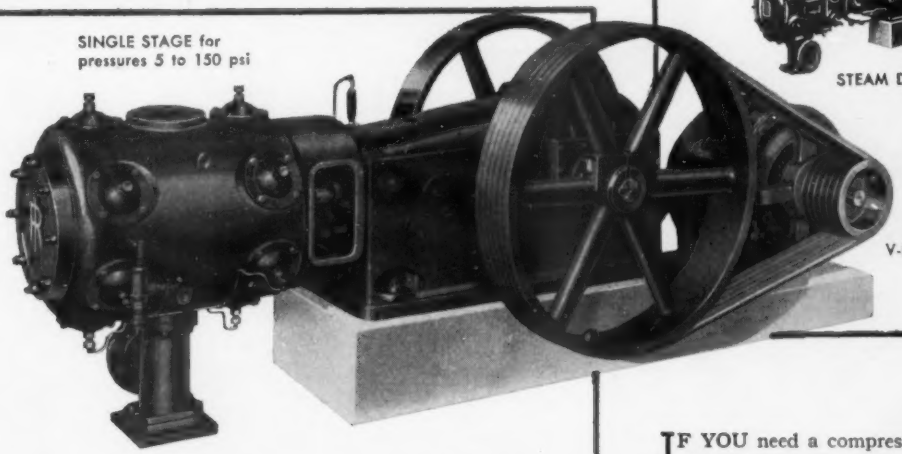
OVERHEAD MOTOR



DIRECT-CONNECTED SYNCHRONOUS MOTOR

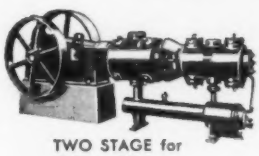


STEAM DRIVE

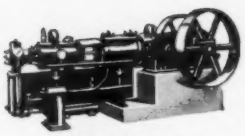


SINGLE STAGE for pressures 5 to 150 psi

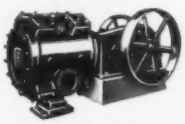
V-BELT DRIVE



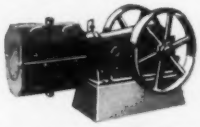
TWO STAGE for 150 to 500 psi



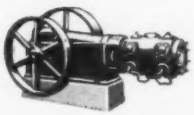
THREE STAGE for 500 to 2500 psi



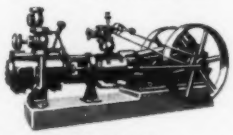
DRY VACUUM PUMPS . . . single or two stage



STEAM-PRESSURE BOOSTERS



NON-LUBRICATED CYLINDERS for oil-free air or gas



REFRIGERATION UNITS for ammonia or other refrigerants

IF YOU need a compressor for any of the following purposes you should consider the Type "ES" compressor . . . a standardized, yet extremely flexible compressor built by Ingersoll-Rand, the pioneer compressor builder.

- To compress air or gas to any pressures between 5 and 2500 psi, or for pulling vacuums. (Stock cylinders are normally available for all frame sizes, see illustrations.)
- For capacities requiring from 5 to 125 horsepower. (Six frame sizes are available.)
- For continuous full-load operation day after day, week after week.
- For handling poisonous, inflammable, or other gases where leakage must be avoided.
- Where compressed air or gases must be free of all traces of oil. (Type NL cylinders require no oil, glycerine, grease or water for lubrication.)
- Where a future change in pressure conditions may call for a change in cylinder sizes.
- Where power cost is an important factor.
- To act as an economical standby unit for larger compressors whose full capacity is not required at all times.

Ingersoll-Rand

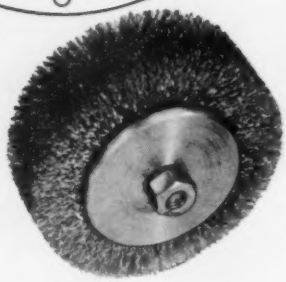
11 BROADWAY, NEW YORK 4, N. Y. *Offices and Agents throughout the World* 859-1

COMPRESSORS • TURBO-BLOWERS • ROCK DRILLS • AIR TOOLS • CENTRIFUGAL PUMPS • CONDENSERS • OIL AND GAS ENGINES

ROTOJET®
Tube Cleaners

Clean tubes and pipes from ½" to 12" I.D. THOROUGHLY QUICKLY

ROTOJET Model 512 Air-driven Motor, universal joint, swing-frame head, and solid brush.



Our large stock of Rotojet air-driven and water-driven tube cleaners, accessories, and repair parts for straight and curved tubes, pipes, and transfer lines is available to meet most requirements without delay. Tube cleaner specialization for 43 years assures satisfactory results from any Rotojet equipment we recommend. Send for Bulletins J-410 and R-105. For quick action wire or phone, HUmboldt 3-0570.

ROTOJET Model C-525 Air-driven Motor with swing-frame head and universal joint.

ROTOJET Model C-526 Air-driven Motor with pivot head and universal joint.

ROTOJET Junior Model S32 Air-driven Motor, universal joint, cone cutter.

ROTOJET Junior Model C434 Air-driven Motor flexible coupling, expanding brush.

ELLIOTT COMPANY-ROTO DIVISION

153 SUSSEX AVE. • NEWARK 1, N. J.

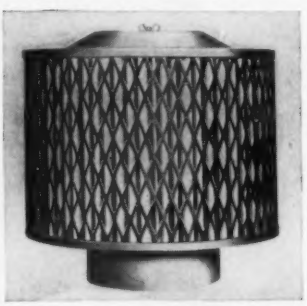
More EQUIPMENT NEWS

Begins on page 162

pecially suited to installations where dampness or corrosive action are encountered. It is available in single, two and three strand construction. Additional details available in manufacturer's bulletin RF-1.
Rome Cable Corp, Rome, New York

Electric Heaters

415 • New line of electric heaters for 5-gal. drums are especially suitable for substances that might be damaged by overheating. Heaters simply wrap around drum to apply heat uniformly. Above is a 300-w unit for melting chemical plastisols. In this case, wire is insulated with glass and silicon with tough nylon outerbraid. It plugs into 115-v circuit. Other sizes and ratings can be built to order. Full details are available on request to manufacturer.
Pre-Fab Heater Co, Guilford, Conn.



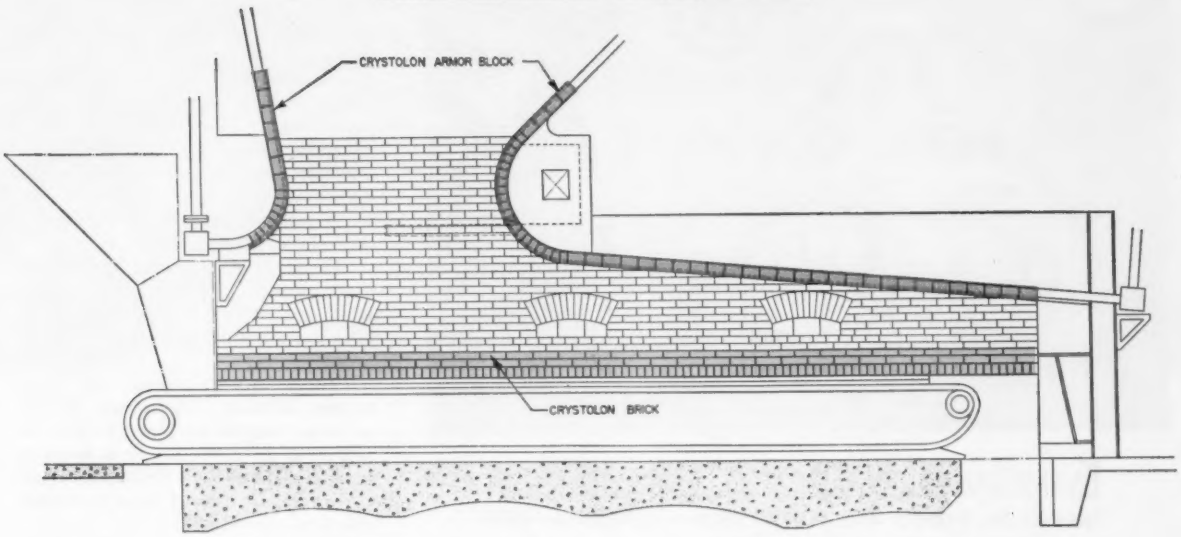
Intake Air Filter

416 • *Type FS* intake air filter for small portable or stationary engines and compressors employs rayon-flocked screen wire as filtering medium. Thermoplastic bonding agent is impervious to gasoline or other solvents. Unit operates either dry or oil-coated with very little difference in efficiency. When oiled, dust holding capacity is comparable to that of viscous-type filters. Available in seven sizes, *Type FS* filters cover capacity range of 50 to 800 cfm. Complete data available in Bulletin No. 135.
American Air Filter Co, Louisville, Ky.

Cartridge-type Deionizer

463 • New cartridge-type deionizer produces solids-free water at rate of five gphr. Two models are available for single and triple-distilled water. No electric controls are necessary; mixed resins change color as exchange capacity of unit becomes exhausted.
Illinois Water Treatment Co, Rockford, Illinois

CRYSTOLON* Refractories give vital protection — *two ways*



Norton brick and armor block provide two money-saving Rx's — reduce abrasion and safeguard water tubes

This diagram of a chain grate, stoker fired boiler shows how abrasion of the setting by moving fuel has been cut to a minimum. Three to five courses of CRYSTOLON brick at and above grate level are all that are needed. The extreme hardness of this Norton *engineered and prescribed* refractory gives the same excellent results where severe flame erosion is encountered.

Above this brick, the diagram also shows how the water tube front and rear arches are protected against hot, swirling gases by CRYSTOLON armor blocks. Their high heat release supports combustion and preheats any infiltrated air from the ash pit entering the main boiler section.

*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

New booklet gives you the whole story

The above is just one of the applications described in the new Norton 24-page illustrated booklet on *Refractories For Heat and Power*. To learn how these highly efficient, quality-controlled refractories supply a performance-improving Rx for every boiler application, write for your copy today. NORTON COMPANY, 443 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto 5, Ontario.

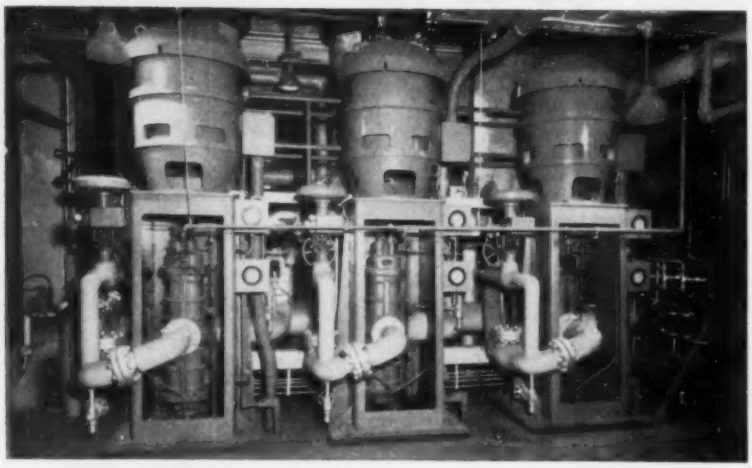
NORTON REFRACTORIES

Engineered . . . Rx . . . Prescribed

Making better products . . . to make other products better

WARREN-QUIMBY SCREW PUMPS USED in the PROCESS of GENERATING STEAM for the WORLD'S TWO HIGHEST TEMPERATURE STEAM TURBINES at

Public Service Electric and Gas Company



ENGINEERING progress marches on and the installation of two of the world's first 1100°F. steam turbines at the new Kearny Station of Public Service Electric and Gas Company in New Jersey, marks another important advancement. Two 145,000 kw. reheat units have initial temperature of 1100°F., pressure of 2350 psig, and reheat temperature of 1050°F. Utilizing these advanced steam conditions results in definitely lower generating costs.

Three Warren-Quimby Gear-in-Head, Vertical Screw Pumps were selected for fuel oil service in connection with this important installation. These pumps are of cast steel with center bearing, and handle Bunker "C" fuel oil at an operating temperature of 125 to 135°F.; viscosity 1500 to 2500 S. S. U.; capacity, 180 g.p.m.; 1150 r.p.m.; suction pressure, 20" Hg. lift; discharge pressure 775 psig.

Keep in step with progress . . . specify:

WARREN QUIMBY PUMPS

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC.

Warren, Massachusetts

MARMADUKE

Continued from page 150

things to do just then to start tearing down diesels that had been working OK, according to what the new chief could learn from the crew.

"A week later, just as I finished my work on the boat, all subs at that base got sudden orders to shove off to some rendezvous. The pack was then to attack a Japanese convoy steaming full speed toward an invasion point.

"'You might as well come along,' invited my friend, the sub's commanding officer. 'Chances are we'll need you before this is over.'

"We shoved off but, after only a short time, the diesels started heating up. The chief and I checked those engines from stem to stern with a fine-tooth comb. Only thing I could figure was that there just wasn't enough cooling water going through the water-jackets. And of course, since the pumps were driven from the crankshafts, there was no way to rev them up.

"Suddenly the chief remembered the directives and broke out in a cold sweat. He looked them up and there it was. The new impellers under the floor plates were obviously the answer.

"As calmly as he could, he reported to the skipper. 'I'll have to slow down a few revs because the engine temperatures are shooting up over the danger point.'

"'SLOW DOWN!' roared the commander, blowing a gasket and getting his own temperature up. 'Unless we keep this speed for the next fourteen hours we'll miss that rendezvous—and the convoy. Or didn't I make that clear before we shoved off?'

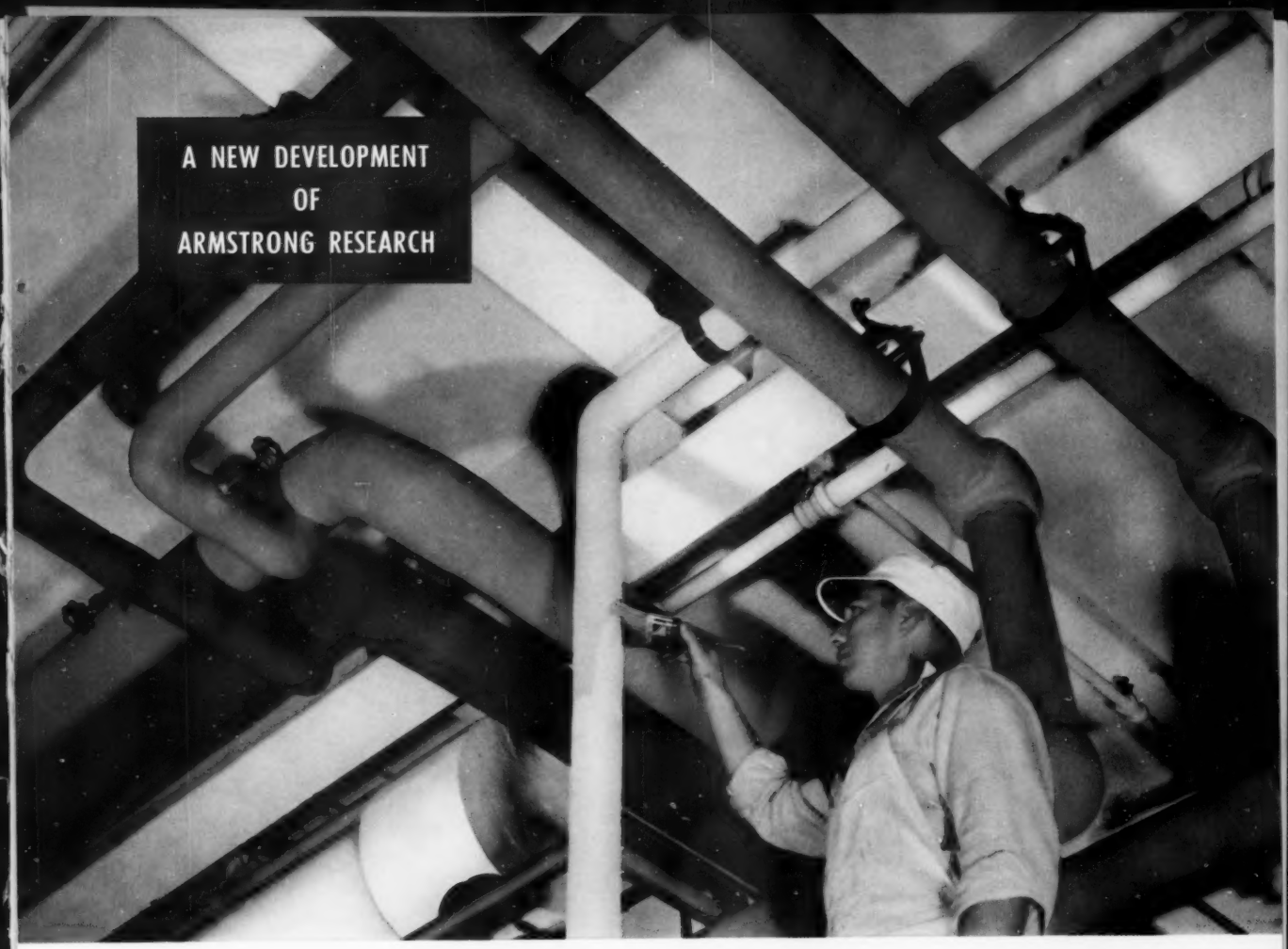
"'Then we'll have to stop for about an hour to replace the cooling water impellers,' answered the chief, getting his own voltage up. 'And if they work okay,' he added quickly as a convincer, 'we should do enough extra revs to make up that lost hour. It's either that or we'll burn up the engines.'

"I won't repeat what the commander said about salesmen who are made engineering officers aboard submarines, but he said *plenty*. Anyway, there wasn't anything to do but shut down.

"After digging the new impellers out from under the floor plates, we went into high gear. In less than an hour the engines were running with their fuel throttles wide open. And there was no sign of overheating.

"The commander just did make his rendezvous at 2 am and the pack ambushed the Japs exactly as planned. For the next few hours we played tag with that convoy. When it was all over, our sub had sent three Japanese ships down to Davey Jones' locker.

(*Continued on page* 210)



Insulcolor . . . *a new plastic finish for insulated lines, tanks, ducts, and cold rooms*

Here's a new kind of insulation finish that also serves as color identification. It's Armstrong's Insulcolor, a newly developed plastic coating for use on high- and low-temperature installations in either indoor or outdoor locations.

Armstrong's Insulcolor dries to a smooth, attractive finish that is rugged and durable. It will withstand a wide range of temperatures without cracking or crazing. Insulcolor is both fire and moisture resistant, easy to maintain.

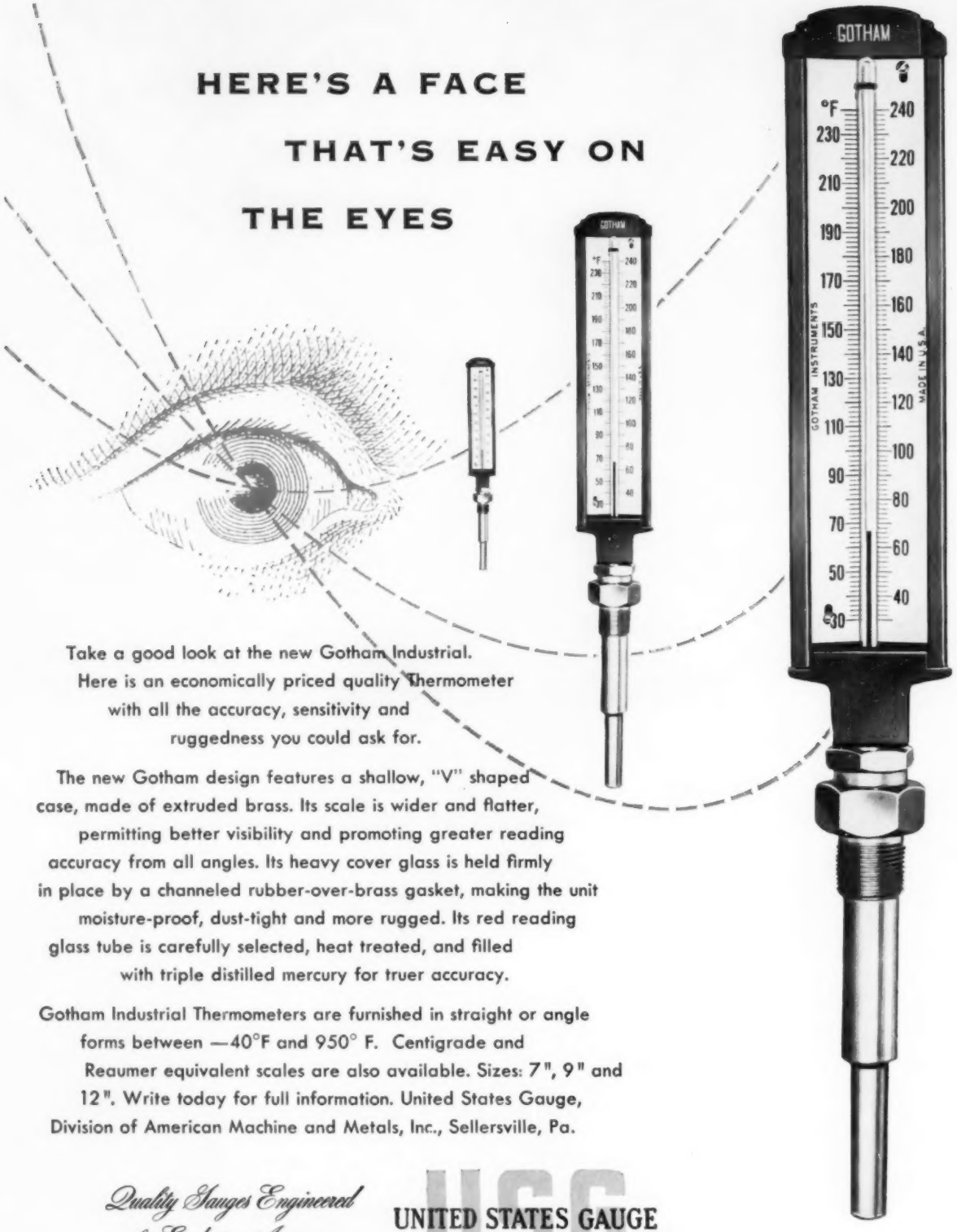
It is quickly and easily applied, eliminating many of the steps required with standard finishing methods. Available in a choice of seven colors and white, Armstrong's Insulcolor cuts the expense of additional painting of insulation surfaces for identification or decoration.

Insulcolor is another example of ways Armstrong's research is developing insulation materials and methods that simplify application, reduce costs. For full details on Insulcolor and Armstrong's Complete Contract Service, call your nearest Armstrong office or write Armstrong Cork Company, 201 Stratton St., Lancaster, Pennsylvania.

Insulcolor's rugged properties give it the durability needed to withstand severe outdoor service. In the photo above, white Insulcolor has been applied to an overhead line at one of the plants of E. I. du Pont de Nemours and Company, Inc.

ARMSTRONG'S INDUSTRIAL INSULATIONS

HERE'S A FACE THAT'S EASY ON THE EYES



Take a good look at the new Gotham Industrial. Here is an economically priced quality thermometer with all the accuracy, sensitivity and ruggedness you could ask for.

The new Gotham design features a shallow, "V" shaped case, made of extruded brass. Its scale is wider and flatter, permitting better visibility and promoting greater reading accuracy from all angles. Its heavy cover glass is held firmly in place by a channeled rubber-over-brass gasket, making the unit moisture-proof, dust-tight and more rugged. Its red reading glass tube is carefully selected, heat treated, and filled with triple distilled mercury for truer accuracy.

Gotham Industrial Thermometers are furnished in straight or angle forms between —40°F and 950° F. Centigrade and Reaumer equivalent scales are also available. Sizes: 7", 9" and 12". Write today for full information. United States Gauge, Division of American Machine and Metals, Inc., Sellersville, Pa.

Quality Gauges Engineered for Enduring Accuracy

USG

UNITED STATES GAUGE

PRODUCTS OF UNITED STATES GAUGE... Absolute Pressure Gauges • Aircraft Instruments • Air Volume Controls • AltitudeGauges • Boiler Gauges Chemical Gauges • Mercury, Gas, and Vapor Dial Thermometers • Glass Tube and Industrial Thermometers • Flow Meters • Inspectors' Test Gauges Precision Laboratory Test Gauges • Marine, Ship and Air-Brake Gauges • Voltmeters • Ammeters • Welding Gauges.

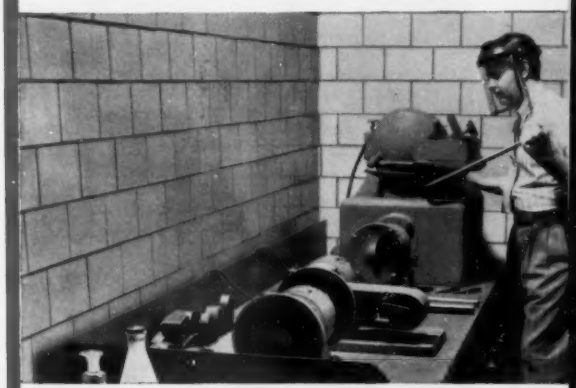
OTHER DIVISIONS OF AMERICAN MACHINE AND METALS, INC. AT SELLERSVILLE, PA.: GOTHAM INSTRUMENTS, AND AUTOBAR SYSTEMS

Heat-treating and physical testing equipment shown at left is used for quality control of welding operators and for development of new welding procedures.

This Rockwell hardness testing machine measures the hardness of weld specimens as a guide to proper procedures for heat-treating of welds.

Daily rigid testing is your insurance of quality welds in

NAVCO FABRICATED PIPING



A laboratory technician cuts a sample from a pipe weld prior to grinding and polishing for metallographic examination.

At Navco, a continuous parade of weld specimens are processed in the new, modern physical-chemical testing laboratory. It is here that weldments are studied metallographically and tested physically—all on a rigid schedule of quality control practices. Navco customers have benefited from progressive quality control practices for more than 40 years; they have come to know that piping installations, engineered, fabricated and erected by Navco, are precise, accurate and dependable.

Call on NAVCO for your next piping job.

Here a weld specimen is etched to outline the grain structure for further metallographic study.

NATIONAL VALVE & MANUFACTURING COMPANY

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New York • Chicago • Cleveland • Boston • Atlanta • Buffalo • Cincinnati

"NO SHUT-DOWNS WITH LUBRIPLATE"

—say HENRY & WRIGHT of Hartford, Conn.

"While waiting for delivery of one of our 25-ton Dieing Machines to do a particularly heavy job, a customer was trying to start production of a 10-ton machine. Even though it was lubricated with a conventional grease every eight minutes, the machine had to be shut down for bearings to cool during each coil run. Then, on our recommendation, he changed to a LUBRIPLATE Lubricant. With but two applications of LUBRIPLATE a day, the machine operated continuously except during change of coils."

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE is available in grease and fluid densities for every purpose... LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

MARMADUKE

Continued from page 205

"But the stinger of this story," roared Marmy, puffing away at his cigar, "is that in changing those impellers, the chief discovered those pumps were made by his firm. And to make it still worse, those little pumps were the *only* things they did make on that entire sub.

"After flying back to Pearl, I learned that submarines in that class had passed their trials because they were tested in the cooler waters of our East Coast. So they didn't give trouble until operated at full speed in the warm waters of the South Pacific.

"Soon as the first sub had trouble, the Navy checked up. They found the impeller volutes didn't jibe with the original design. Then the pump firm checked and found that under round-the-clock wartime conditions, so many impellers had been cast from the same wooden patterns, that the patterns had worn so they couldn't meet their maximum designed rating.

"But they hurriedly made a batch of impellers that were right and shipped them to the Navy supply depots. Then the Navy rushed the new impellers and installing directives to all subs of that class.

"Last time I saw the chief after the war," wound up Marmaduke, pulling a fist-full of cigars out of my pocket, "he was back with his old firm selling pumps. He told me he learned one thing he'll never forget. That's when a buyer isn't satisfied, he goes out of his way to investigate and make things right. That experience while chasing that Jap convoy showed him that many things can go wrong with machinery without being the buyer's fault, or even the maker's fault—it just happens.

"And another thing," added Marmy, getting back to his work. "I've learned to test all new equipment at maximum capacity—and under anything but ideal conditions—before accepting it. And the operator just can't afford to overlook instructions of any kind. He might get by for awhile, but when things do catch up with him, it may be too late."

—*SME*

AUTOMATIC AUTO GEAR

Continued from page 123

any time after the turning-gear stop button is pushed. Interlocks prevent main motor interfering with turning gear.

If the chance tooth-to-space relationship of idler and bull gear is not right for entering into mesh, the engagement is rejected. Piston then recedes to back position and turning-gear motor is au-

Enco

OIL BURNERS

have these

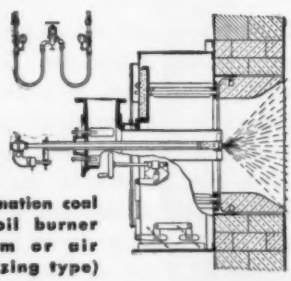
7 ADVANTAGES

in pulverized coal fired boilers...

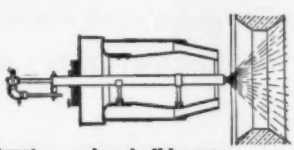
They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

- **They warm up cold furnaces**
- **They ignite pulverized coal—safely**
- **They assure continuous operation in case coal system fails**
- **They provide efficient and safe operation on bank and at low loads**
- **They respond almost instantly to sudden load changes**
- **They permit operation with oil or coal—whichever is available and lowest in cost per BTU.**
- **All capacities of steam, air or mechanical-atomizing types are interchangeable**

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 75 West St., New York, N. Y.



Combination coal and oil burner (Steam or air atomizing type)



Combination coal and oil burner (Mechanical atomizing type)

Enco Burners

WHEN CONTROL VALVES
ARE CONSIDERED . . .

It's Automatically the Finest!

IN . . .
ENGINEERING
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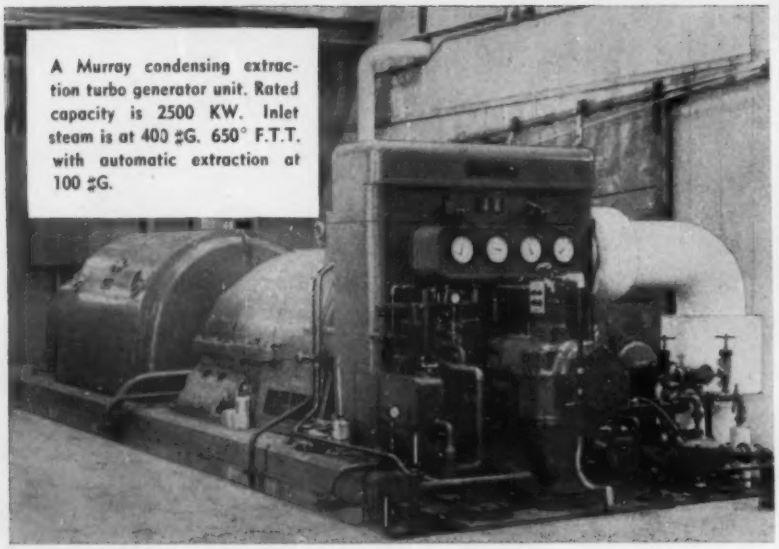
MANUFACTURING PLANTS IN WARWICK, R. I., U. S. A., CANADA, ENGLAND, FRANCE AND HOLLAND

Murray Turbines



A Murray condensing extraction turbo generator unit. Rated capacity is 2500 KW. Inlet steam is at 400 #G. 650° F.T.T. with automatic extraction at 100 #G.

Murray Turbo Generator units can be furnished to meet your special requirements in sizes up to 3000 KW. Condensing and non-condensing types with or without extraction and/or mixed pressure features can be furnished. Whether you require a small inexpensive standby unit or a highly efficient, and reliable source of power, Murray has a design to fit your needs.

Consult your local Murray representative who will gladly help you select the unit most economically suited to your conditions.

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE-QUARTERS OF A CENTURY

AUTOMATIC AUTO GEAR

Continued from page 210

tomatically jogged changing the tooth-to-space relationship. Once again the piston returns idler to bull gear for another trial meshing. Rejection may occur several times. However, engagement is automatic and "start" button need not be pushed again. Remember that yoke and piston are not integral. If floating idler does not mesh properly, it will not be forced into position, but yoke and pinion will recede with the piston under gravity.

If floating idler reaches full depth of mesh during trial start, the main turning-gear motor will be started automatically. This applies torque in driving direction, maintaining floating idler in engaged postion and leaving actuating piston free to recede. But, should the main motors start, the reverse reaction forces will disengage the teeth without interference.

Trial run of 150 engagements showed the average time from pushing button to drive was 27.7 sec using 3.94 cycles per engagement.

Idler gear may be left in engagement when turning gear is stopped. Any subsequent start or inching will be direct and immediate since the gears are already engaged. They'll disengage when main motors are started, rotating the bull gear, releasing the idler so it rolls down the inclined ways where it remains till turning gear is again started.

A hold-down inching button permits rotating compressor through part of a revolution. If turning gear is not engaged when inching button is held down, the same electro-mechanical engagement sequence described above, takes place. The only difference is that the button is held down until compressor is moved the desired amount.

HIGH-TEMPERATURE WATER

Continued from page 99

Table below shows how few stages of regeneration are required to obtain the major portion of the theoretical benefit with a htw-process heat-power cycle.

No. stages	*% of power output with infinite regeneration*
1	50
2	67
3	75
5	83
9	90
19	95
99	99

Cycle Comparisons. Fig. 4a and 4b show a steam-process and htw-process cycle having the same pressures and

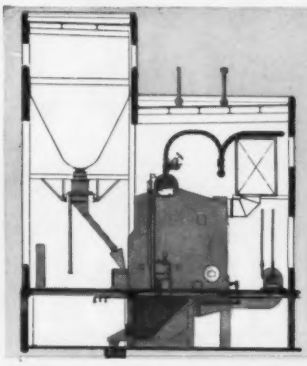
"74.2% MORE STEAM PER DOLLAR–

that's what this modern coal installation gives us at Perfection Stove Co.!"

says George I. Chittenden, consulting engineer for the Perfection Stove Company.

Perfection's old installation, if operating today, would generate 1,362 lbs. of steam per hour per dollar. The new plant produces 2,373 lbs. of steam per hour per dollar. Here's proof of the economy and efficiency of bituminous coal burned with modern equipment.

This view of Perfection Stove's new steam plant shows the coal elevator and ash silo. Coal is delivered through an under-track hopper, lifted by elevator to storage. A pneumatic system carries ashes to the silo.



This sectional drawing of the plant's boiler installation shows the coal bunker over the firing aisle. A weigh larry with dust-proof connection feeds coal to the stokers. The plant is clean and efficient—typical of the modern design that makes full use of coal's inherent advantages.

If you operate your own steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

● More and more consulting engineers are advising their clients that *bituminous* coal is the best buy for steam fuel. *Here's why:* Nearly everywhere coal yields more BTU's per dollar . . . modern combustion installations step up this inherent economy . . . up-to-date coal- and ash-handling systems cut labor costs to a minimum.

Tremendous reserves give coal a future dependability of supply no other fuel can offer. And to mine this coal, America has the world's most productive and efficient coal industry—making coal the one fuel most likely to remain reasonably stable in price.

If you're building or planning to modernize a steam plant, call in a competent consulting engineer. He'll show you how a modern coal installation can save you money and do a more efficient job, too!

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
WASHINGTON, D. C.

FOR HIGH EFFICIENCY *FOR LOW COST*

YOU CAN COUNT ON COAL!

the **new**

Type "DE"

Coffin turbo pump

Superbly engineered to keep pace with increasing steam pressures, the new type "DE" is a highly efficient single-stage, high-speed, steam turbine-driven centrifugal boiler feed pump.

At *no extra cost,* unit is equipped with both a *speed-limiting governor* and a *pressure regulator* operated by a powerful oil relay which prevents over-speeding and provides shut-down upon loss of oil.

The unit has varied industrial uses, particularly in the oil and chemical fields for boiler feed and other services. The pump covers a Volumetric Range to 800 GPM, Discharge Pressure to !000 PSIG, Steam Temperatures to 850° F., Exhaust Pressures to 80 PSIG, and Liquid Temperatures to 325° F. For special installations these ratings can be exceeded.

Write for the new, 6 page Illustrated "DE" Bulletin P 154.

THE
J. S. COFFIN, JR.
COMPANY
326 South Dean Street Englewood, New Jersey Cable Address: COFCO
Representatives in the United States, Canada, Europe, and the Far East

HIGH-TEMPERATURE WATER

Continued from page 212

temperatures and the same power output for the high-pressure turbine, 8000 kw. Steam pressure at turbine inlet is 400 psia, temperature 650 F. Send-out pressure is 190 psia, with regeneration at 60 psia. Water returns at 200 F and is heated to 293 F by the 60-psia heater and to 377 F by the direct-contact 190-psia heater.

Low-pressure or regenerative turbine in steam cycle produces 868 kw, or 1/5.8 of the 5048 kw produced by the htw cycle. This is because 0.489 lb of 1272-Btu-per-lb steam is diverted to htw l-p turbine, whereas only 0.0841 lb reaches l-p turbine in the steam cycle.

Quantity of water to be heated by 60-psia heater determines how much steam passes through the l-p turbine. Only the condensate (0.828 lb) requires heating in the steam cycle, whereas 4.814 lb of htw must be heated. The ratio of 5.8 is that of the latent plus the sensible heat given up by the process steam ÷ sensible heat rise of the htw (or of the steam condensate). This ratio varies widely with send-out pressure and return temperature. Table below gives a few representative values.

Send-out press., psig	*Temp, F*	*Ratio, (200-F return)*
25	267	14.6
50	300	10.0
150	366	6.4
300	421	5.0

This range of values shows the steam-process cycle can at best produce only one-fifth to one-fifteenth of the power of the htw-process cycle. So those who have rejected using regenerative heaters in steam-process cycles should investigate the possibility of using the htw-process cycle.

Balancing power output with heat requirements is one of the most difficult problems that arises in industrial plants. This brings us back to the cop. for these cycles. We can express the cop. in more practical terms as the kw per million Btu per hr process heat.

Fig. 5 shows this parameter as a function of send-out pressure for various typical turbine admission conditions. Dashed curves show the tremendous amount of additional power the htw cycle produces with perfect regeneration and admission pressures of 400 and 800 psia. Note the 400-psia admission-pressure cycle produces almost as much power per given heat load as the 1200-psia nonregenerative steam or htw cycle. The 800-psia cycle gives twice the power of the nonregenerative when send-out pressure is 200 psig.

Backpressure must be selected at times after the admission pressure is predetermined by other conditions. Let's

ANKORITE

ROTARY SHAFT SEAL

overcomes the serious problem of fluid or gas leakage

A new item in the Anchor line is the Anchor Rotary Shaft Seal . . . designed to give you a positive mechanical seal that eliminates the costly problem of fluid or gas leakage experienced with conventional type packings and other mechanical seals.

The basic design of this seal is the essence of simplicity. It is constructed and designed in such a way as to prevent the liquids being handled from coming in contact with the sealing members. From parts which are carried in stock at our factory, seals for specific installations can readily be assembled with a minimum amount of special machine work, resulting in prompt deliveries.

The Anchor Rotary Shaft Seal has proved itself in countless numbers of applications throughout industry, meeting requirements under widely varying operating conditions. Its success is noted when used from slow to high speeds . . . from vacuum to extreme pressures . . . temperatures to 350 deg. F. . . . pumping a wide range of liquids from light fluids to heavy abrasive slurries.

For full details and advantages of Anchor Rotary Shaft Seals, write us today, or contact our nearest branch office.

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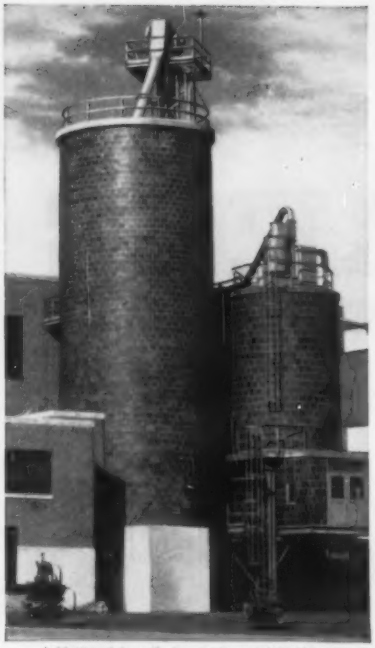

A National Installation at the MEMORIAL HOSPITAL in Westville, Indiana

turn the
EXPERIENCE
OF OTHERS
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HIGH-TEMPERATURE WATER

Continued from page 214

assume we need a plant to produce 15,000 kw and 400 million Btu per hr with 400-psia 650-F admission. Send-out pressure for a steam cycle would have to be about 60 psig to meet the cop. of 37.5 kw per million Btu per hr. An equivalent htw plant with full regeneration and a send-out pressure of 150 psig gives a cop. of 54 kw per million Btu per hr. A 3-stage regenerative cycle achieving 75% of this would give the desired heat to power ratio. High send-out pressure cuts the investment in distribution piping, a saving that more than compensates for the additional equipment needed.

Gas Turbines. The relatively low thermal efficiency of gas turbines when exhaust heat is not recovered has discouraged their application when competing with steam turbines and diesel engines. But when exhaust heat is recovered, gas turbines can operate with over-all plant efficiencies as high as 70 to 85%. They can produce substantially more power per Btu of heat delivered than can steam turbines. With htw for process heating, the effectiveness of the heat exchanger used to recover exhaust heat is quite high.

Fig. 5 shows that simple gas-turbine cycles can deliver as much as 140 kw per million Btu per hr, when steam is the heat-recovery medium. With htw, higher plant efficiencies can be obtained because the exhaust-gas temperature can be reduced without exceeding an economical amount of heat-transfer surface. More heat is delivered for a given plant kw output.

With heat recovery for process, gas turbines are most flexible for adjusting the power to heat ratio to meet operating changes. Htw permits even greater flexibility because its heat accumulation capacity is high and the ease with which hot exhaust gases can be cooled by a fluid instead of a boiling vapor.

Temperature-entropy diagram, Fig. 6, shows a simple gas-turbine cycle with a pressure ratio of 4 and a turbine inlet temperature of 1500 F. Without heat recovery this plant has an efficiency of about 15%. Recovering the exhaust heat ups the thermal efficiency to about 76%, based on an exhaust temperature of 350 F. This temperature level is unnecessarily high for htw used in process heating. Table below shows variation in cycle efficiency with exhaust temp.

Exhaust temp, F	*Plant eff, %*
100	96
200	88
300	80
400	72
700	47

Less heat-recovery surface is needed

Make Accurate BOILER WATER pH, PHOSPHATE TESTS *this simple way*

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B. Add reagent to middle tube only.

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in ash hoppers

✔ A large power plant had to repair a number of ash hoppers, remove spalled and shaled fire brick and replace with new material. Estimated cost—$30,000, plus considerable boiler outage. But R & I recommended thorough raking out, cleaning and wetting down of all broken, spalled and eroded areas, and the holes and openings filled and plastered with Moldit-D Refractory Cement to a smooth, level surface. This was done more than 10 years ago. Today the Moldit-D refractory is still in place, withstanding hard usage and frequent, large quantity cold water quenchings of the hot ash. All this at about one-fourth the estimated cost!

✔ Heavy repairs to ash hoppers with prolonged shut-downs used to cost another large power plant many thousands of dollars until they tried Moldit-D. As a result, maintaining these hoppers of eight 500,000-lb. stoker-fired boilers as well as a number of smaller boilers has been cut about 90% a year.

✔ The Moldit-D linings installed eleven years ago in ash hoppers of two 800,000-lb. pulverized fuel boilers are still going strong. Not a single repair has been necessary! The original application was made on the walls and ends of the hoppers, at a cost of a few cents per pound, plus very little labor. Figure this out in terms of labor and material for equivalent fire brick lining including the cost of maintaining and repairing it for eleven years. It would be staggering!

The Moldit success story is endless—wherever refractory linings are used. There's a Moldit Cement for every castable refractory need.

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HIGH-TEMPERATURE WATER

Continued from page 216

with htw to lower the exhaust-gas temperature because a larger temperature gradient is available to a circulating liquid than to a vapor-heating system. Fig. 7 shows a typical exhaust-gas cooling curve, the htw heating curve, and the corresponding curve for heating condensate to the boiling point and evaporation of the condensate. Superheating the steam would be even more unfavorable.

As Fig. 7 shows, the area of htw heating surface is less than for steam because the water has a 77% greater effective temperature difference. Note that there is no limit to the temperature to which we can heat the liquid other than the temperature limitations of the piping and equipment. This raises the possibility of using a liquid other than water. By choosing a high-temperature heat-transfer liquid, there will be little or no pressure in the system. This may prove to be an important application for gas turbines.

Cycle Balance. Fig. 8 shows a simple cycle like that we've just discussed, but it includes bypasses *A* and *B* and an additional combustion chamber *C*. When heat is not needed, the regenerator is put into service by means of bypass *A* and the heater is bypassed by *B*.

When process heat is needed, bypass *B* is diverted more toward the heater until the surface reaches full effectiveness and thermal efficiency increases from 25 to 75%. If more heating is needed, combustor *C* can produce the additional requirements without significant loss in thermal efficiency.

To reduce power output while continuing to deliver heat the combustor *C* can be used or a direct fire applied to the water heater.

This article is based on a paper presented before the American Power Conference in March 1954.

More PLANT PROBLEMS

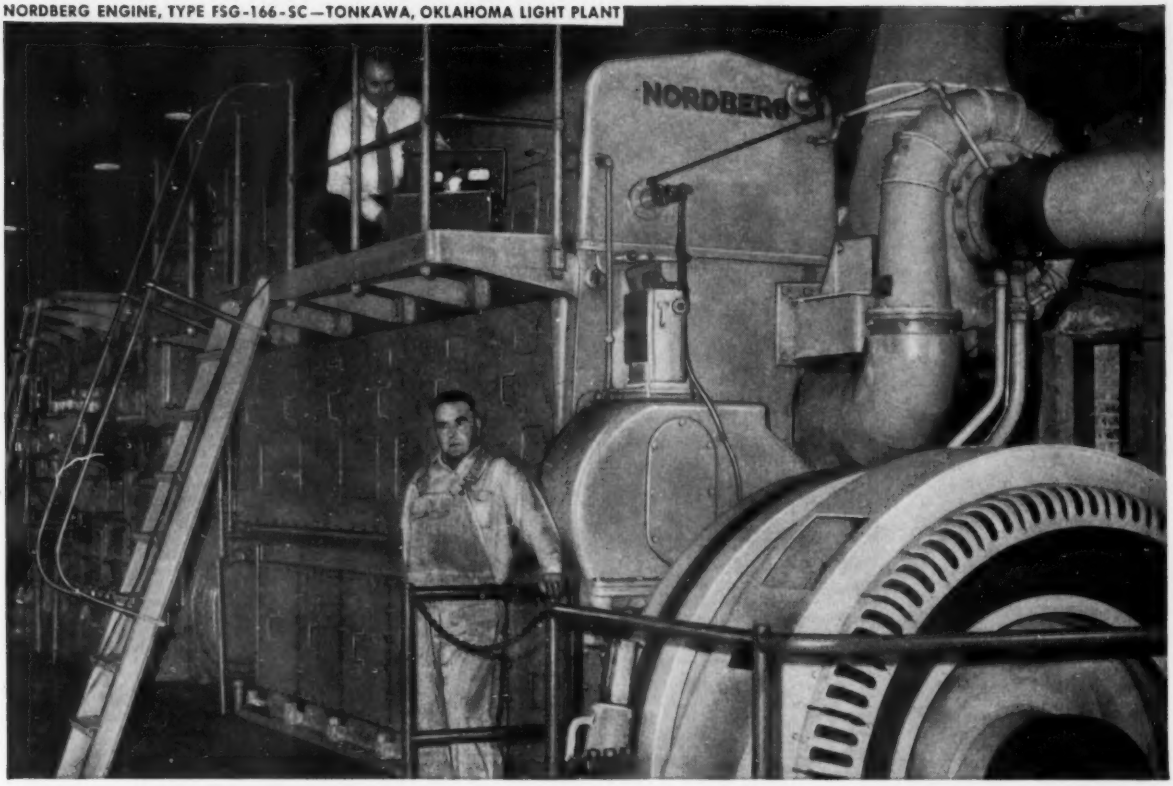
Begins on page 138

orifice, the heat loss when discharging to the atmosphere can be as high as 233 million Btu per month. A ⅛-in. orifice will pass about 2000 lb per hr of water when the inlet pressure is 400 psi. This capacity may not be high enough to rid the header of water or condensate during an emergency.

One point often overlooked when choosing an orifice is that the bore will eventually wear and the flow through the opening will increase.

Sketch shows a portion of a pressure-

NORDBERG ENGINE, TYPE FSG-166-SC—TONKAWA, OKLAHOMA LIGHT PLANT



30,000 HOURS, NO WEAR!

MICROMETER MEASUREMENTS			
LINER MEASUREMENTS		WITH CRANK	90° TO CRANK
#1 Liner	Top	16.004"	16.008"
	4" down	.003"	.006"
	8" down	.0035"	.007"
#2 Liner	Top	16.003"	16.002"
	4" down	.002"	.001"
	8" down	.001"	.0005"
#3 Liner	Top	16.005"	16.007"
	4" down	.004"	.006"
	8" down	.003"	.008"
#4 Liner	Top	16.003"	16.004"
	4" down	.004"	.005"
	8" down	.001"	.002"
#5 Liner	Top	16.004"	16.000"
	4" down	.003"	.000"
	8" down	.003"	.001"
#6 Liner	Top	16.003"	16.0015"
	4" down	.0015"	.0015"
	8" down	.0015"	.0005"
(Original machine shop tolerance—16" plus or minus .001")			

No Wear On Rings Or Liners With Great Cities Service Diesel Oils!

When the Tonkawa City people pulled this Diesel off the line for periodical inspection, it had logged 30,038 hours and was approximately six years old. After they had the engine torn down, micrometer measurements were taken on the cylinder liners. THEY COULD FIND VIRTUALLY NO APPRECIABLE WEAR ON RINGS OR LINERS!

They were so amazed that they had another man in the plant take his own micrometer readings. Still not certain that an engine could run that long with so little wear, they had the micrometer itself checked! The instrument checked out perfectly!

Men who have worked with Diesel Engines all their lives have said that they've never seen an engine with that much time in service with so little wear. Obviously, a great deal of the credit must go to the maker of these splendid engines, but also, credit must be given to the high-quality, wear-reducing Cities Service Diesel Oils used in this engine. You'd be wise to buy yourself this kind of inexpensive diesel-engine protection too. Call your nearest Cities Service Office or write Cities Service Oil Company, Sixty Wall Tower, New York City 5, N. Y.

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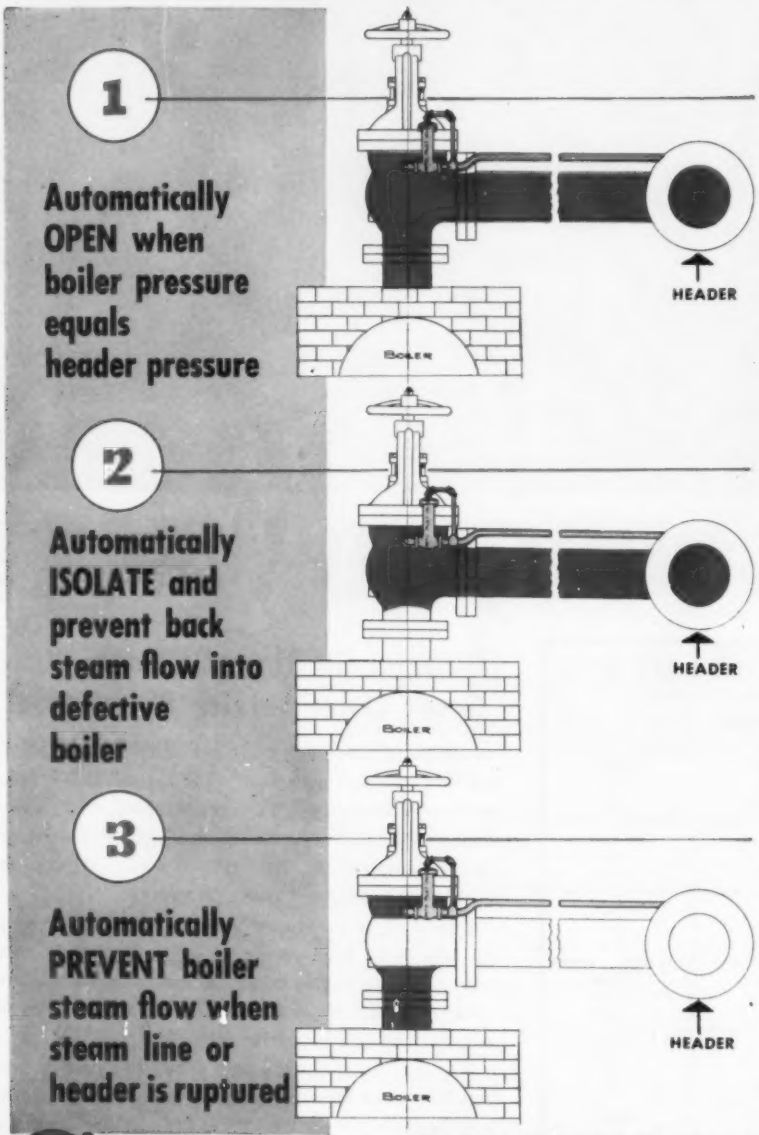
Triple Acting Non-Return
VALVES
Control Boiler Steam Flow SAFELY



The Golden-Anderson triple-acting non-return valve may be also used to control flow of air, gas or hot water. Bulletin S-1A gives complete details.

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DESIGNERS AND MANUFACTURERS OF:
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Float Valves • Pressure Reducing Valves • Surge Relief Valves for air, gas, steam and water

More PLANT PROBLEMS

Begins on page 138

reducing and desuperheating station recently designed by the writer. The 8-in. vertical header contains 420-psi 750-steam. There is little likelihood water will accumulate in this header except during start-up. Steam in the 12-in. header is at 180 psi, 750 F. Though it will normally contain only steam, there is a possibility that failure of the desuperheater may allow too much cooling water to be injected into the header.

The 8-in. header is trapped as shown, with the trap discharging to the 12-in. header. Condensate from the high-pressure header is completely recovered for use at the lower pressure. Trap on the 12-in. header discharges to a deaerator operating at 1 to 5 psi. Thus, there is no heat loss from this system.

E H ROPER *Toledo, Ohio*

FORGED STEEL TRAPS are best for high pressures and temperatures. Sketch shows piping arrangement we use for a standby boiler-feed pump. We want to start this unit with minimum trouble from condensate that collects in the line during idle periods.

BZ's best bet is use of traps for resible from using hot condensate elsewhere in the plant. Work closely with a trap manufacturer and you will get best results.

ARTHUR BELTON *Montreal, Canada*

AN ORIFICE does not give accurate control of condensate discharge. So a throttling valve on the upstream side of the orifice is needed to control condensate flow. Use a globe valve for this service. An orifice is not recommended where the discharge is wasted.

Drain valves have disadvantages similar to orifices. Lack of control of condensate flow is a potential hazard to operating personnel and equipment.

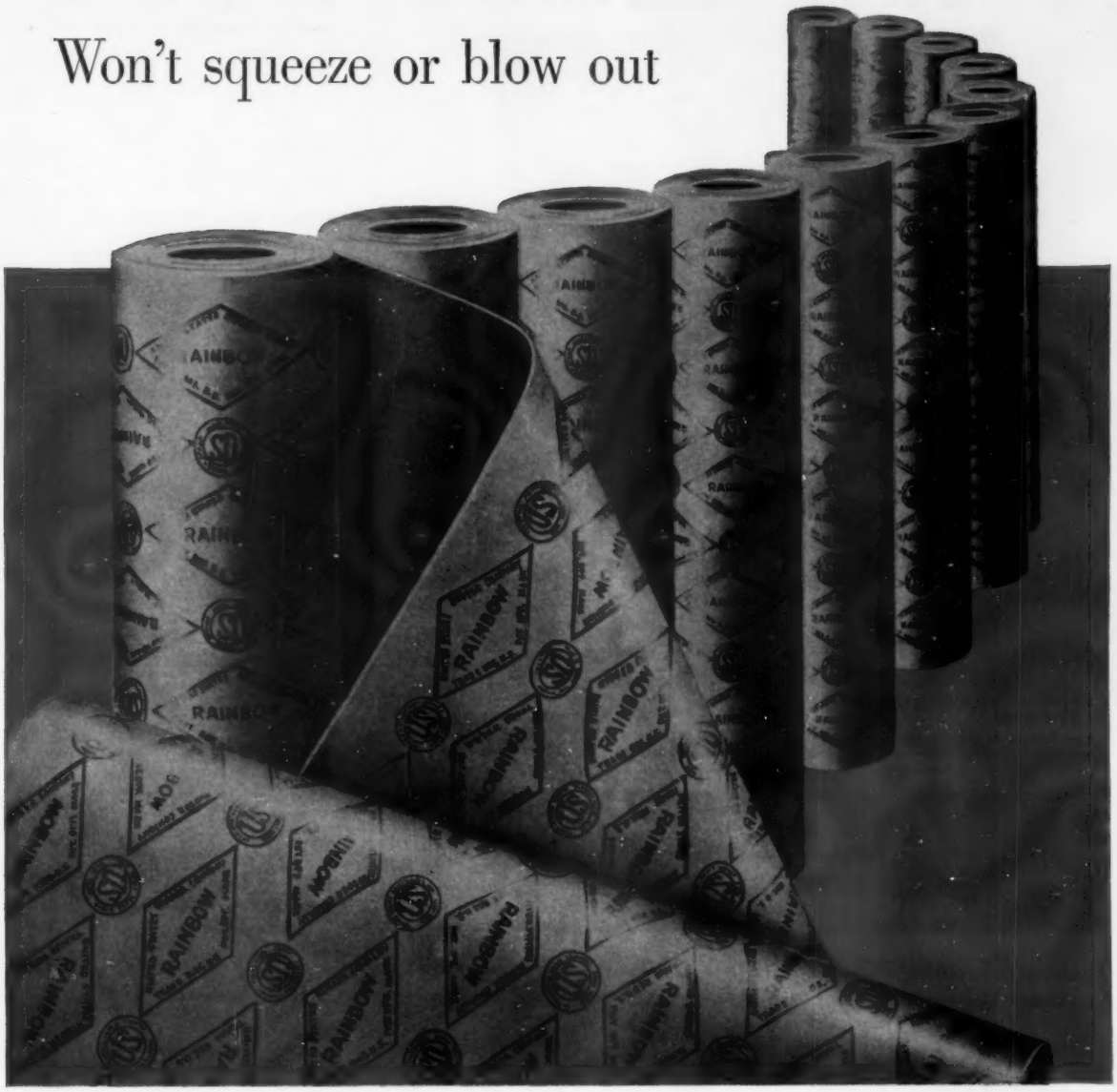
BZ's best bet is use of traps for removal of condensate from superheated steam lines. Various types—impulse, bucket, float, etc—are suitable for this service.

H B WAYNE *Brooklyn, N. Y.*

WE USE drains, valves and traps in combination. On a 12-in. main conveying superheated steam we have a condensation rate of about 3 lb per hr where traps are spaced 200 ft apart. We figure this is the normal radiation loss from the bare trap and its fittings.

Traps serve our needs best when shutting down the line and when a reducing valve closes. We follow manufacturer's recommendations in sizing a trap but *BZ* can neglect warm-up condensate and possible boiler carryover if he has drain valves that are regularly opened by an

Won't squeeze or blow out



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The big point about Rainbow is that it will never blow or squeeze out. It is so pliable that it fills up any irregularities in the flange and is highly resilient. *Yet it is always firm enough to make a tight joint.*

For packing flanges and other parallel surfaces against hot or cold water, air, saturated steam pressures up to 150 pounds, and all hydraulic conditions, play safe and pick Rainbow. Look for its familiar diamond trademark. Quick delivery from any of the 25 United States Rubber Company District Sales Offices, or from the address below.

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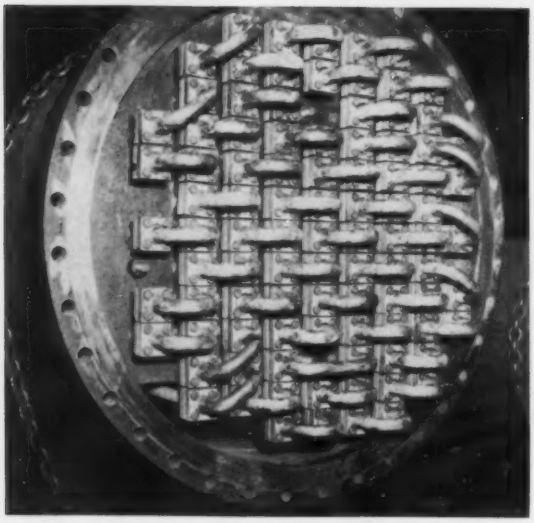

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More PLANT PROBLEMS

Begins on page 138

operator during warm-up or an emergency.

L F O'CONNELL *Dearborn, Mich.*

BEST SOLUTION to *BZ's* problem is traps. An orifice wastes too much steam if allowed to blow free. Manual drain valves usually aren't satisfactory because they are too easily forgotten. Also, condensate may form in superheated steam lines, even when they are in operation. Traps remove it automatically, preventing damage to turbines and other equipment. We usually connect our traps to low points in the lines or where the lines change direction.

E W MCKNIGHT *Chapel Hill, N. C.*

RIGHT PROCEDURES during start-up and shut-down can be a big help to *BZ*. When no valves are used on the main steam line between the nonreturn valve and the turbine throttle, manual bleed valves can be installed just ahead of the throttle. Steam traps can be used in the same location. Even with traps, manual bleed valves are useful for checking the condition of the steam before start-up.

When shutting down, it is sound practice to open the bleeds to permit tne steam to escape. This prevents accumulation of large quantities of condensate in the header or steam line.

JERRY TRNCAK *Houston, Texas*

BETTER ECONOMY is obtained with traps than with manual control. With the right size trap, there's no steam loss during line operation. Sudden slugs of condensate are quickly and efficiently removed by traps.

JOHN KALMAN *Clifton, N. J.*

DOUBLE-VALVED drain connections at all low points and at line obstructions give good service. Locate drain valves close to the pipe to avoid formation of a water leg. Indoor drains can be led to the blowdown tank or waste. Outdoor drains can be blown to the atmosphere, care being taken to avoid injuring personnel.

Trap superheated steam lines when there is any possibility of saturated steam entering the line during load changes or emergency conditions.

R N OLSEN *Brooklyn, N. Y.*

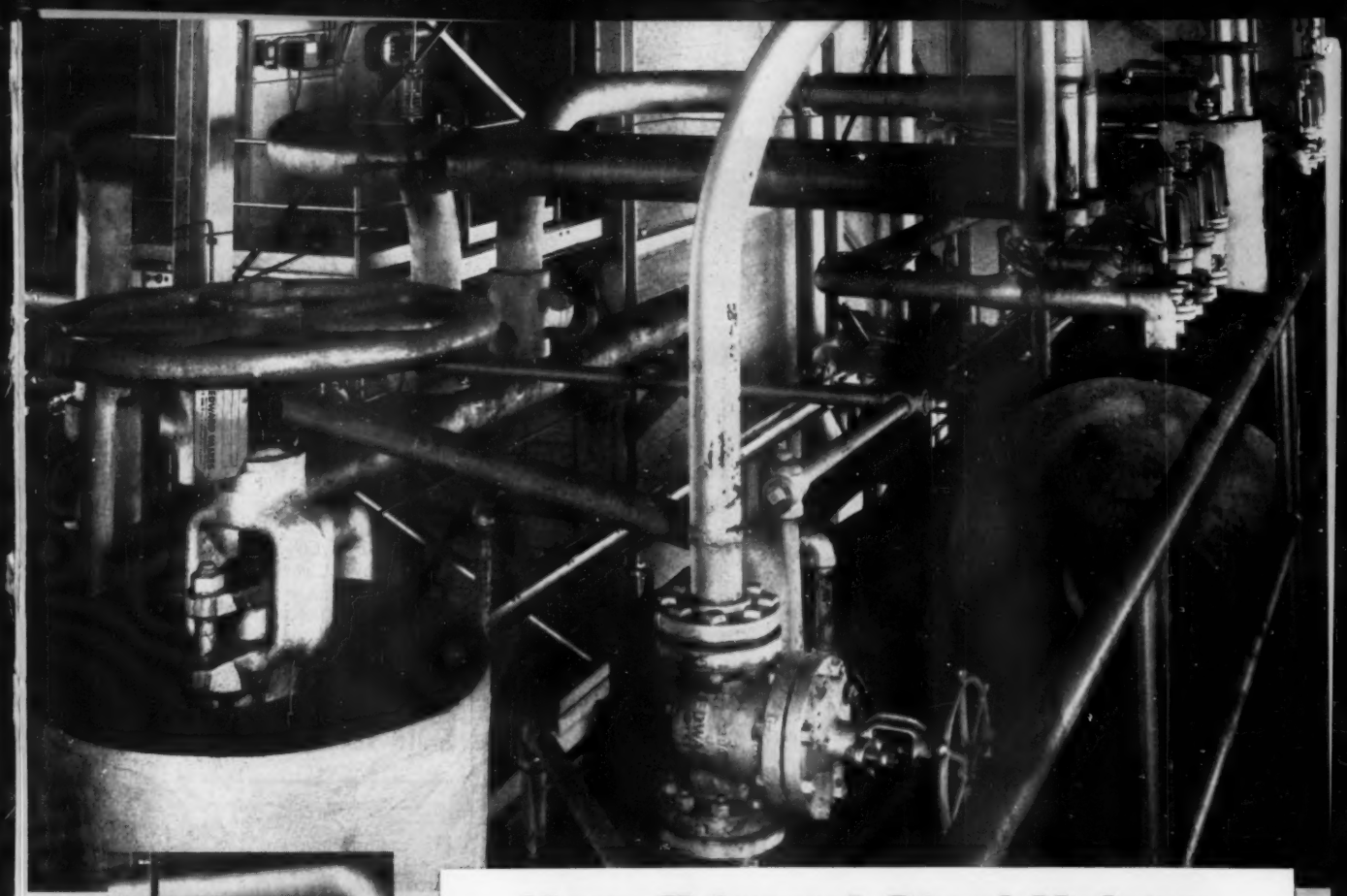
Other readers sending good answers, for which we lacked space, are:

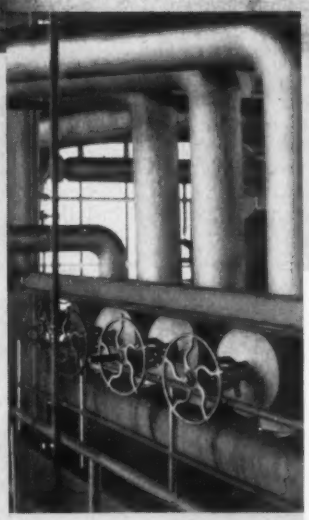
JAMES SMITHWICK *Washington, D. C.*

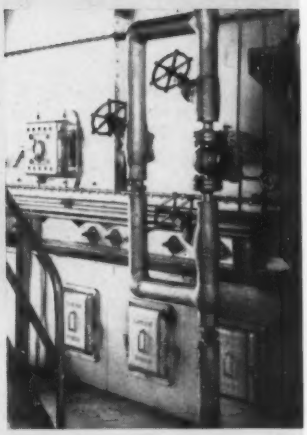
L W FITZPATRICK *Jefferson City, Mo.*

HENRY RASMUSSEN *Crystal Lake, Ill.*

C G HOWARTER *Canton, Ill.*







How Edward Steel Valves Cut Maintenance in a Hospital 150 lb sp Boiler Plant

RAY D. GANGWER, Chief Engineer, Gets Dependability, Saves on Replacements and Repairs with Steel Valves

Buying EDWARD 300 lb sp steel valves for 150 lb sp service proved a good investment at The Dr. Norman M. Beatty Memorial Hospital, Westville, Indiana.

Years ago, labor for repairing or replacing valves was relatively inexpensive. But, today, labor often costs more than the valve. So, for economy, the feedline, non-return, main steam distribution, blow-off and miscellaneous drain, gage and auxiliary valves in this steam generating plant are steel.

Maintenance personnel at the hospital like trouble-free Edward steel valves. Edward's dependability and low maintenance requirements more than justified their slight additional cost over the usual low pressure valves.

You, too, can cut your maintenance expense with low-cost Edward steel valves. Call the nearest Edward representative or contact Edward Valves, Inc., today.

The first of a series of case histories on the use of Edward steel valves in "under 300 lb sp" service.

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DART

UNIONS

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HEADWORK

Continued from page 148

first line says that one atom of carbon combines with two atoms of oxygen to produce one molecule of CO_2. Note that both sides of the equation have the same number of each kind of atom.

The second line gives the weights of the atoms and molecules in atomic units, figured from the fact that an atom of carbon weighs 12 and one of oxygen weighs 16.

You could just as well call these pounds, because the *proportions* are fixed. So you know that 12 lb of carbon will burn with 32 lb of oxygen to produce 44 lb of CO_2. If you divide each of these by 12, you see that one pound of carbon burns with 2.67 lb of oxygen to produce 3.67 lb of CO_2.

More TECHNICAL BRIEFS

Begins on page 158

standpoints. With use of heavier joints required by higher pressure, gas leakage is reduced to a value comparable with that of present machines operating at 30 psig.

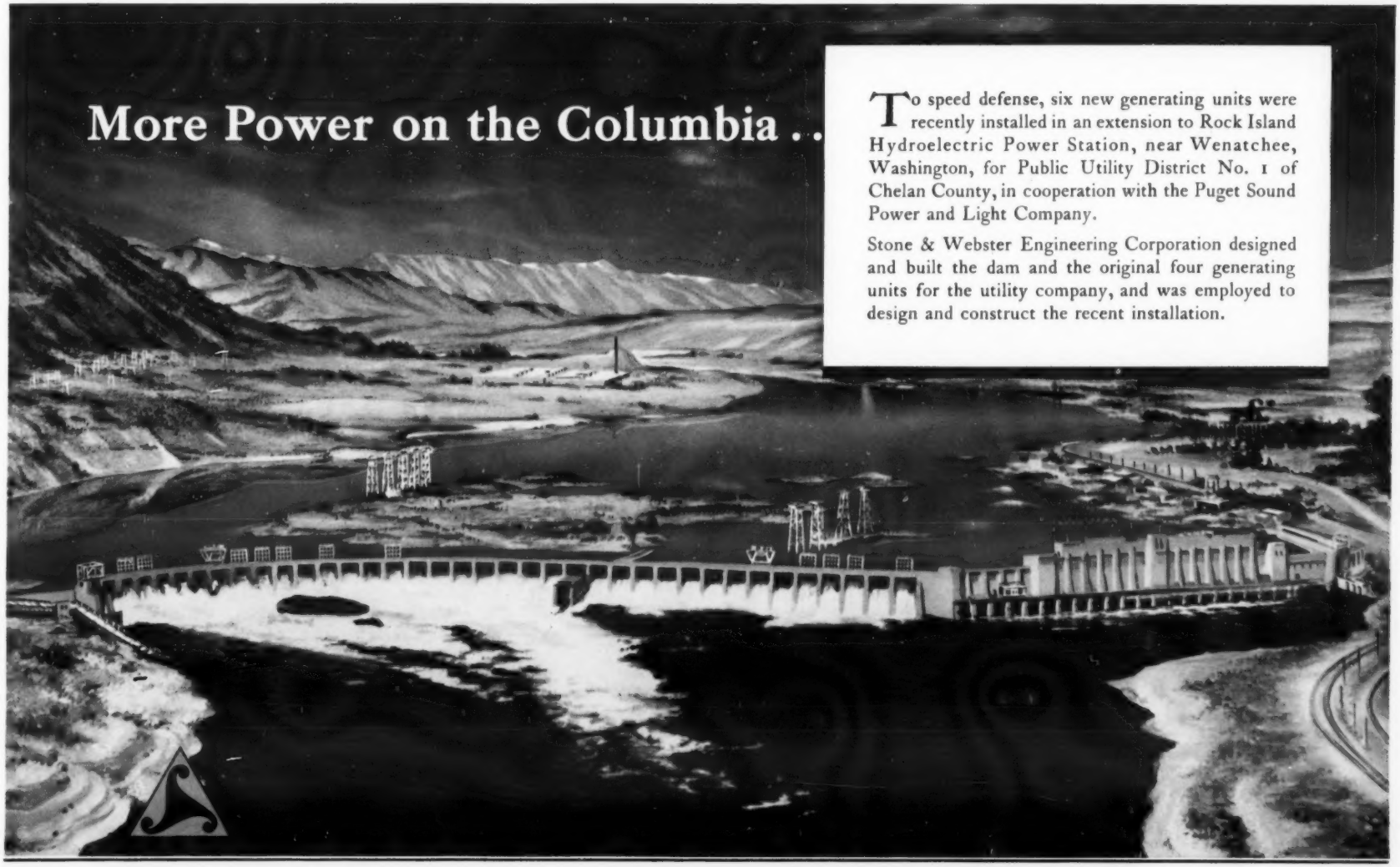
Inner-cooling of turbine-generator rotors and stator windings make it possible to build machines of high specific ratings with modern hydrogen pressure. Reduction in rotor size, plus reduction in quantity of gas circulated through machine, permits use of high-pressure blowers and results in windage losses lower than on conventional units. Maximum copper temperatures are the same as obtained on the standard windings, while average temperatures have been reduced. Refinements in design of joints and glands seals result in lower hydrogen consumption. *AIEE Paper, No. 54-50.*

Directions for ordering papers on p 160

Test Results of an Inner-cooled Generator. *By W C Brenner and P R Heller, both of Westinghouse Electric Corp, East Pittsburgh, Pa.*

Primary objective in developing inner-cooled generator described in previous paper was to raise output above limits imposed on conventional unit by thermal properties of electrical insulation. Shop tests on this machine agree closely with calculated performance and have justified confidence previously expressed in this improved cooling technique. It may be concluded that basic principles of inner-cooling can be applied practically to large turbine gen-

(*Continued on page 228*)



To speed defense, six new generating units were recently installed in an extension to Rock Island Hydroelectric Power Station, near Wenatchee, Washington, for Public Utility District No. 1 of Chelan County, in cooperation with the Puget Sound Power and Light Company.

Stone & Webster Engineering Corporation designed and built the dam and the original four generating units for the utility company, and was employed to design and construct the recent installation.

Write or call us for information as to how our experience may be of assistance to you.

STONE & WEBSTER ENGINEERING CORPORATION

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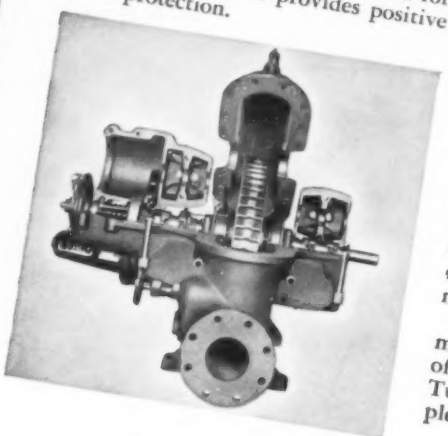
TERRY

PROTECTION OF TURBINE BLADES made possible by nozzle location

The Terry Solid-wheel Turbine is of the impulse, helical flow type. The steam issues from an expanding nozzle at high velocity and enters the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is returned to the wheel several times until practically all of the energy has been utilized. This principle makes possible the efficient use of steam in a single-piece, almost indestructible wheel.

In the Terry Solid-wheel Turbine, the steam enters the buckets in a direction at right angles to the shaft, as shown above. This design eliminates the need for close clearances and provides positive blade protection.



The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, projecting rims on each side of the buckets prevent damage to the blades even though external thrust should move the wheel.

This is only one of the many important features of the Terry Solid-wheel Turbine. Write for complete details.

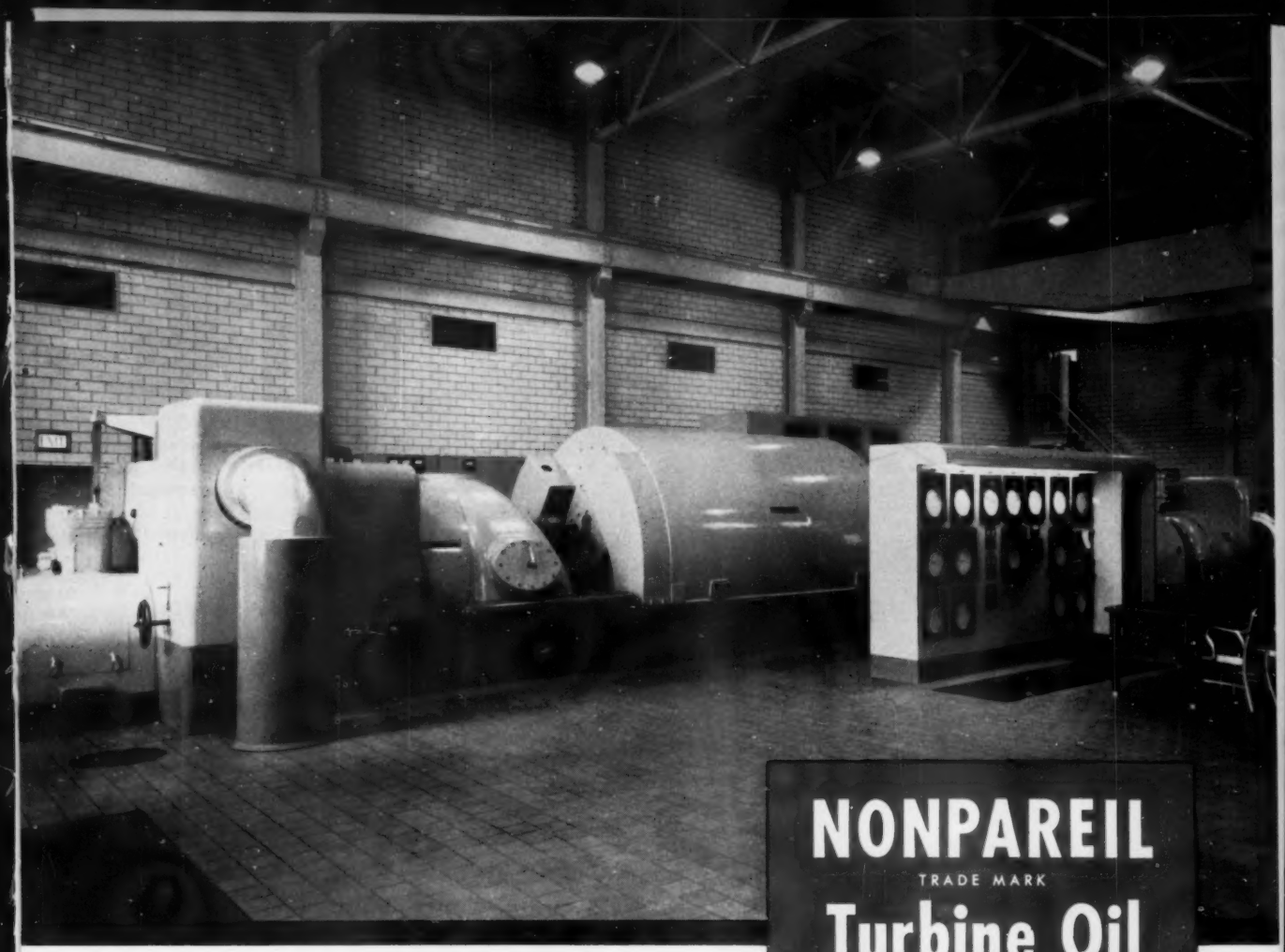
THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TT-1195

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.



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● This turbine, one of the largest industrial units in the Midwest, was recently installed by a leading paper mill. The decision of mill officials to lubricate the new turbine with NONPAREIL Turbine Oil was based on their own experience with this outstanding product.

Beginning in 1941 in one unit, NONPAREIL has since been put into additional turbines; and, today, it lubricates all turbines in this big mill. Over the period of 12 years, it has not been necessary to replace any of the original fills of NONPAREIL because of lubricant deterioration or lubrication trouble. Oil systems have stayed clean. Oil acidity has stayed below 0.07 mg. KOH/gm.

In this mill, as in power plants throughout the Midwest, NONPAREIL has sold itself into one turbine after another. That success has been the result of superior turbine lubrication service. Service records of NONPAREIL cover up to 25 years' continuous operation of individual units on original fills of oil. Moreover, this unique lubricant carries a written guarantee that it will last as long as the turbine it lubricates and that its neutralization number will stay below 0.15 mg. KOH/gm.

The Standard Oil lubrication specialist serving your section of the Midwest will be glad to show you lubrication records of NONPAREIL in installations similar to your own. You can contact this specialist by phoning your local Standard Oil office. Or, write: Standard Oil Company (Ind.), 910 S. Michigan Ave., Chicago 80, Illinois.

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Meanwhile, send for our informative brochure – The Collection and Recovery of Industrial Dusts – it explains all *three* Buell systems of industrial dust collection. For your complimentary copy write Dept. 50-D, Buell Engineering Company, 70 Pine Street, New York 5, N. Y.

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More TECHNICAL BRIEFS

Begins on page 158

erators. Such a construction should remove barrier that formerly limited ratings of machines cooled by conventional means.

At present there are 15 additional units on order having capacities ranging from 90,000 kw to 250,000 kw at 30 psig hydrogen pressure. Total capacity at 45 psi hydrogen pressure is in excess of 3,000,000 kva. With larger systems now in existence, and those anticipated in the future, there should be an increased demand for innercooled machines for even larger ratings. *AIEE conference paper, can be obtained from the authors.*

Hydro Development

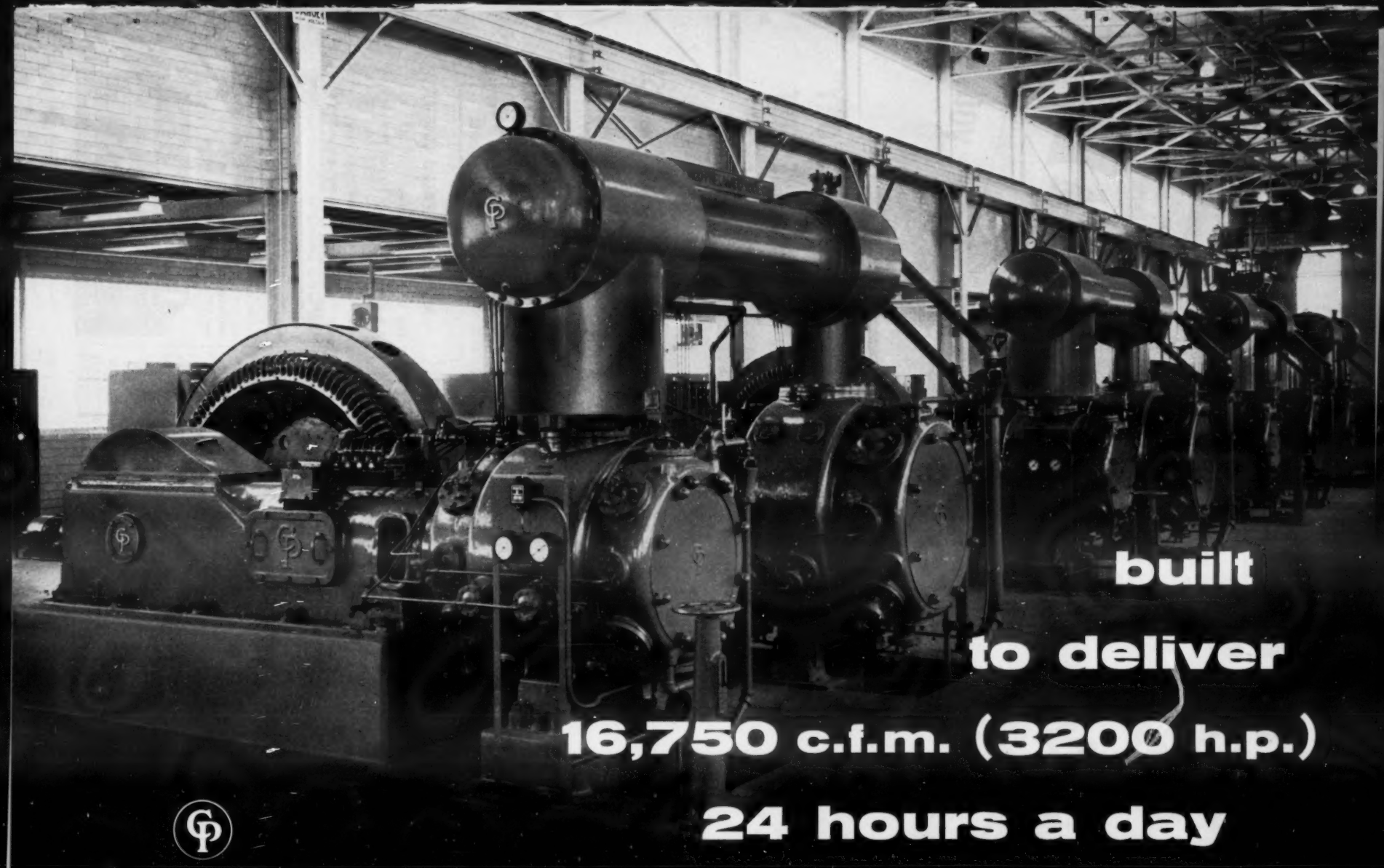
The Wahleach Hydroelectric Development. *By T Ingledow, Fellow AIEE and J H Steede, Member AIEE, British Columbia Electric Co, Ltd, Vancouver, B.C., Canada.*

In December 1952 the Wahleach Plant, a single unit 82,000 hp project was placed in service by B. C. Electric Company operating under a 2000-foot head. To serve it, water is diverted through a two-mile tunnel from Wahleach Lake to a penstock partly underground and partly on surface of steeply sloping Four Brothers' Mountain, a spur of Mount Cheam, to a powerhouse on the left bank of Fraser River approximately seventy-eight miles from river mouth. The single generating unit representing full development operates under supervisory control from Company's central office in Vancouver, a distance of 72 miles.

Associated with this development, but designed for later extension to Company's Bridge River Plant approximately one hundred and ten miles to north, is a transmission line which is first of its kind on North American Continent. This line is designed for 345 kv operation with two parallel conductors per phase. It is presently operating at 230 kv with only one of the two conductors but full insulation has been provided for higher voltage and hardware is in place to permit second conductor to be added with a minimum of change when it is desired to operate at 345 kv.

The tunnel extends from Wahleach Lake 10,830 feet nearly due west toward the Fraser River. Overall slope of tunnel is 0.822 feet per hundred, but tunelling was carried out from both ends on a slightly rising gradient with high point reached where headings met. Tunnel is of modified horseshoe shape being 9 ft 6 in. high and 9 ft wide with a cross-

Directions for ordering papers on p 160



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More TECHNICAL BRIEFS

Begins on page 158

sectional area of 76 sq ft. It is unlined except for five short sections where it passes through fault zones and for last 776-ft section at western end where heavily fractured rock was encountered. Five short sections referred to have concrete linings, while last 776-ft section has a steel lining of circular cross section 7 ft in dia with space between steel liner and surrounding rock back-filled with concrete.

Just upstream from this steel liner tunnel was enlarged in a similar manner, to 20 x 20 ft for a length of 365 ft to form a rock trap. Four concrete baffles 6 ft high are spaced equidistantly along floor of this enlarged section to trap any loose rock which may be washed down from unlined sections of tunnel. Floor of tunnel intake is at elevation 2028 and will allow reservoir to be drawn to elevation 2040. Intake is fitted with steel trash racks to protect water conduit and turbine from floating or submerged driftwood.

To provide for unwatering the tunnel, a roller gate is located in a concrete lined shaft 150 ft downstream from intake. This is a 7x10 ft steel gate filled with concrete and provided with rubber seals on downstream face. Total weight of gate is 21,600 pounds. Gate is operated by a gasoline engine driven hoist designed to raise it at a rate of 1½ fpm. A hydraulically operated release is provided to drop gate to closed position if a tunnel flow should become excessive due to a tunnel or penstock rupture downstream.

In addition a rollerless steel bulkhead gate has been provided to operate in a slot immediately upstream from the roller gate. This will allow roller gate to be removed at times when tunnel is unwatered. Rollerless gate is same size as main gate and is fitted with rubber seals, but is not filled with concrete. It may be raised and lowered only when water is not flowing in tunnel.

Tunnel does not extend through to the surface of the mountain at west end, but rather intersects with underground penstock leading to powerhouse approximately 640 ft in from surface. Surge shaft is located at junction of tunnel and underground penstock and rises from there 243 ft through rock to surface at an angle of 53 degrees. It has a steel liner 10½ ft in dia and here again space between liner and surrounding rock is backfilled with concrete. At surface a vertical steel riser 6¼ ft in dia and 13½ ft high is mounted on top of shaft. Elevation of top of this riser is 2155.

Underground penstock is in two sections; upper or inclined section roughly parallels side of mountain running down

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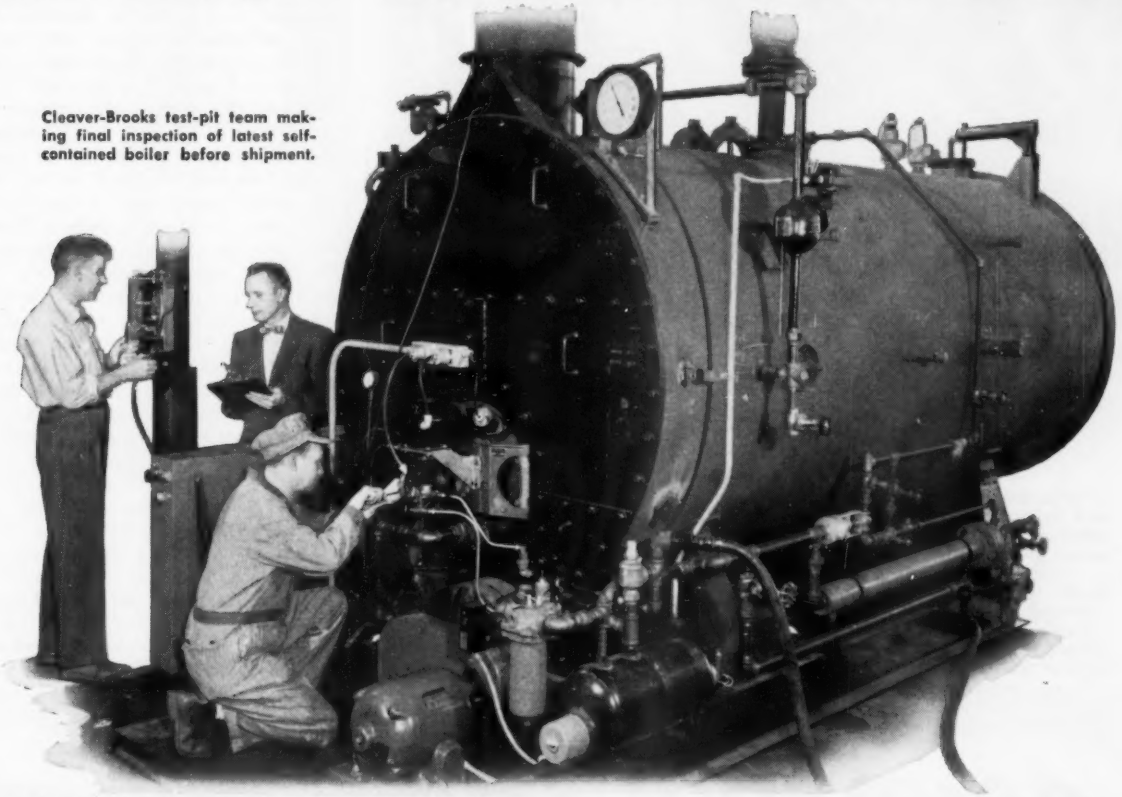

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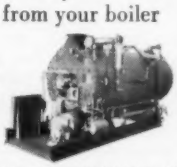

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More TECHNICAL BRIEFS

Begins on page 158

for 1980 ft and an angle of 48 degrees, lower or horizontal section extends for 950 ft from foot of inclined section to face of hillside. Inclined section has a steel liner 6¼ ft in dia in a circular section tunnel 8¼ ft in dia. Plate thickness of liner varies from ⅜ inch to one inch and total weight of liner is 510 tons. Horizontal section has a steel liner 5 ft 10 inches in dia in a modified horseshoe shaped tunnel 9 ft high and 8 ft wide. In this section plate thickness varies from 15/16 inch to 1½ inches and total weight of liner is 470 tons. Throughout length of both sections of this underground penstock space between liner and tunnel walls is filled and pressure grouted with concrete. Steel liner and surrounding rock together carry bursting pressure of water.

From elevation 471 where underground penstock emerges from mountain water is carried through a surface penstock down face of hillside to turbine. This surface penstock was manufactured from high strength steel plate in forty foot sections, 5 ft 10 in. od. Sections are connected together with Dresser couplings, thus providing an expansion joint every forty feet in the 1650-ft penstock. Plate thickness varies from 1 9/16 inches at upstream end to 1⅞ inches at downstream end and total penstock has a weight of 1110 tons. These penstock sections were erected on their individual concrete footings by use of a gantry running on steel rails laid on top of footings and hauled up hill by a hoist.

A 42 inch spherical plug valve is located at junction of underground and surface penstocks. This is an oil-operated valve designed to close automatically should velocity of water flow become excessive denoting a failure of penstock between valve and powerhouse.

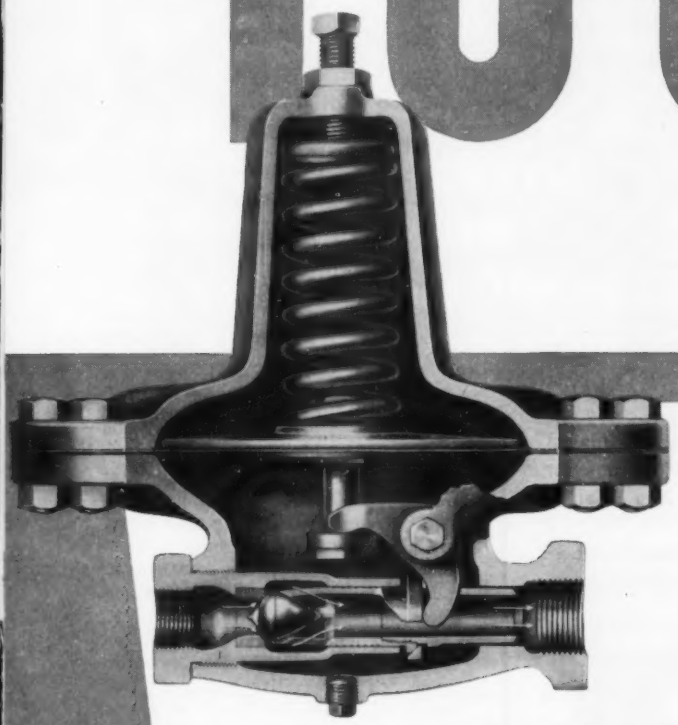
Turbine is of six-nozzle, vertical-shaft, impulse type rated to deliver 82,000 hp at an effective head of 1880 ft and at 360 rpm. Efficiencies of 88 percent at full load and 90 percent at ¾ load have been guaranteed but tests have not yet been made to determine actual values. The six nozzles are supplied from a spiral casing made up of five steel castings, first having an inlet dia of 5 ft 10 in. Diameter of each nozzle is 8 5/32 inches. Jet deflectors are provided to reduce amount of water striking buckets if load is reduced rapidly.

Runner, bolted to bottom of 25-inch dia shaft, has 22 buckets, each 23 inches wide. Runner OD is 125¾ inches and pitch diameter 105½ inches.

Turbine is controlled by a governor

Directions for ordering papers on p 160

TYPE 1000 VALVE



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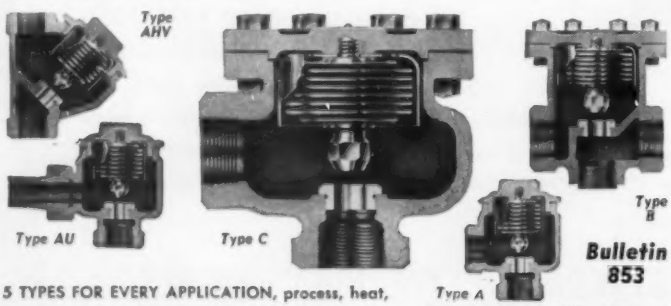

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More TECHNICAL BRIEFS

Begins on page 158

which transmits proper movement to needle valves by a conventional servomotor mechanism through a rock-shaft linkage. Governor is actuated by a hydraulic unit mounted on top of generator shaft. Although this type of unit is now commonly used with steam turbines it is comparatively new in its application in hydro plants.

Generator is rated 75,000 kva, 0.8 lagging pf, 13,800 volts, three phase, sixty cycles, 360 rpm, sixty degrees C rise and has Class B insulation. It is of conventional design; weight of both turbine and generator being supported by one thrust bearing near upper end of shaft. Upper and lower guide bearings are provided. Unit is totally enclosed with eight water coolers on the periphery of the stator absorbing heat losses from circulated air. A CO_2 distribution system is provided for fire protection. Main exciter, pilot exciter and governor control unit mounted above thrust bearing are direct-connected to generator shaft.

Main transformer is rated 75,000 kva, three phase, 60 cycles, 13.8 kv delta to 230 kv Y, with high-voltage neutral solidly grounded. High voltage winding has full capacity taps at 250, 240 and 220 kv with one of reduced capacity at 210 kv. Two forced-oil water-cooled heat exchangers external to the transformer provide necessary cooling, each cooler having sufficient capacity to keep transformer in operation at 75 percent load. Transformer, complete with oil, weighs 157 tons.

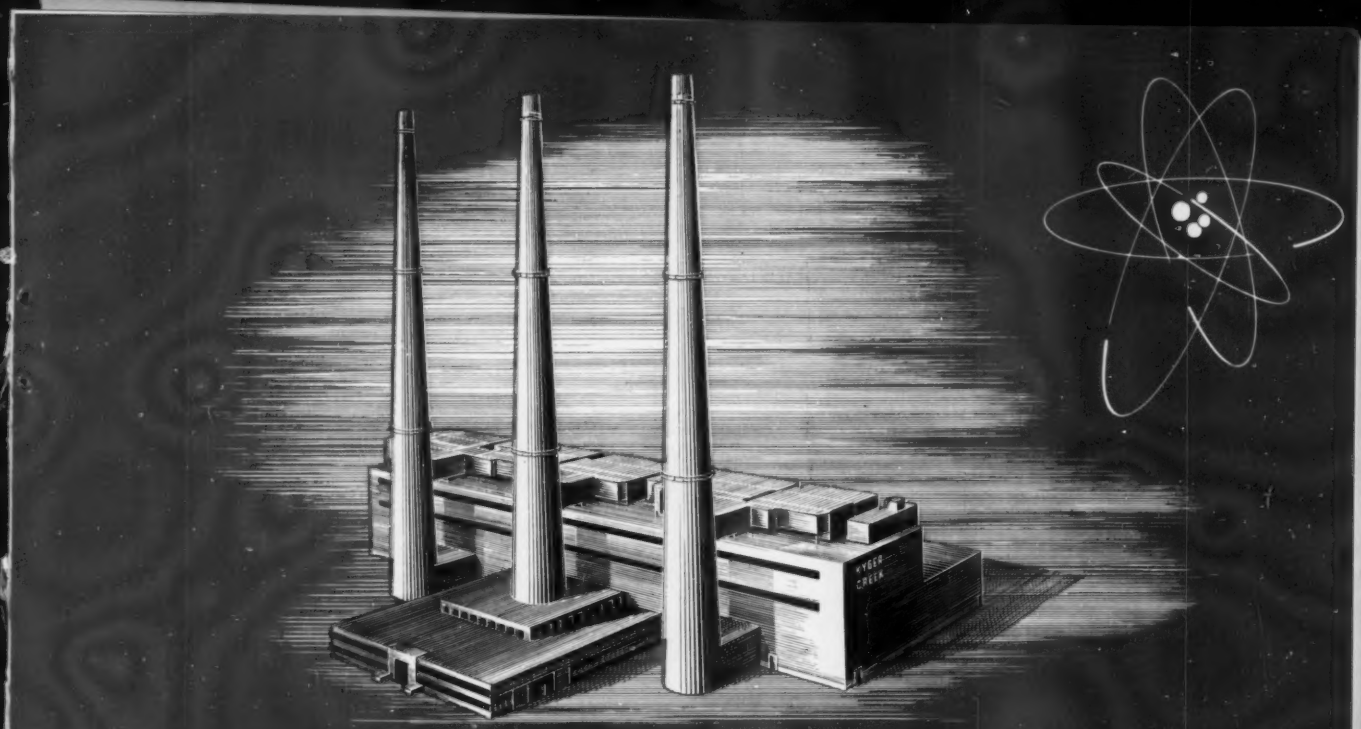
Work has been resumed at the dam site on Wahleach Lake and is being pressed with a view to storing water from June 15th, 1953. Unit has operated on stream flow during past winter and notwithstanding that head is lower than it will be when the dam is completed unit has exceeded its rated output by over six and one-half percent.

Present indications are that data on stream flows largely obtained by correlation are conservative and plant load factor will be higher than was anticipated initially. Experience to date in so far as flexibility of operation and integration of plant operation with that of system as a whole has fully justified planning on basis of a high peaking capability as previously outlined. *AIEE Paper No. 53-327.*

Power Stations

Electrical Features of Eastlake Generating Station, Units 1, 2 and 3. *By C F Paulus, The Cleveland Electric Illuminating Company, Cleveland, Ohio.*

New Eastlake plant 20 miles east of



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Will Have MIDWEST PIPING Throughout

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Below are shown two additional EVERLASTING Duplex Units, each including the EVERLASTING "Y" Valve . . . simple and sturdy in design, with all parts interchangeable with those of the Angle Valve.

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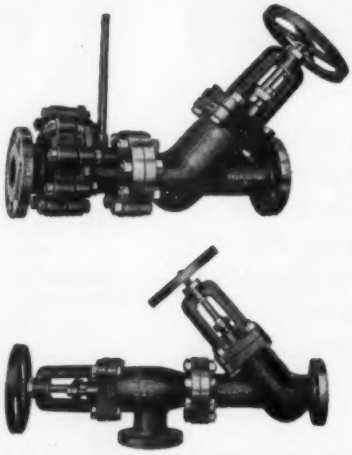

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More TECHNICAL BRIEFS

Begins on page 158

Cleveland is being designed for ultimate capacity of about 1,000,000 kw. Three units are being installed now. Fourth unit will go into service in latter part of 1955. No. 1 unit was first phased-in on September 17. No. 2 will be carrying load by end of this year and No. 3 will go on line in spring. These four units will raise total installed capability of illuminating system to some 1,700,000 kw.

New power source at Eastlake appreciably reduces kw-miles of transmission. This is important because advanced design of this plant gives appreciably lower production costs. This calls for operation at highest plant factor possible.

Plant site of 157 acres is adequate for a station with capacity of a million kw and over. Eight to ten units can be installed. There is space for coal storage in excess of a million tons. Switchyard space and exit right-of-way for as many as sixteen 132-kv circuits are provided.

The 132-kv transmission structure is located beyond intake and outlet forebays. This is of extremely simple design and can be expanded in any direction. The step-up transformers are located by turbine-room wall. Two 33-kv circuits are brought in to provide starting-up service.

Ranch type construction permits concentration of nearly all controls on a single operating floor. Because there are many passageways between floors and because controls are concentrated on a single level, there is much less use of elevators. This simplified arrangement also reduces operating crew.

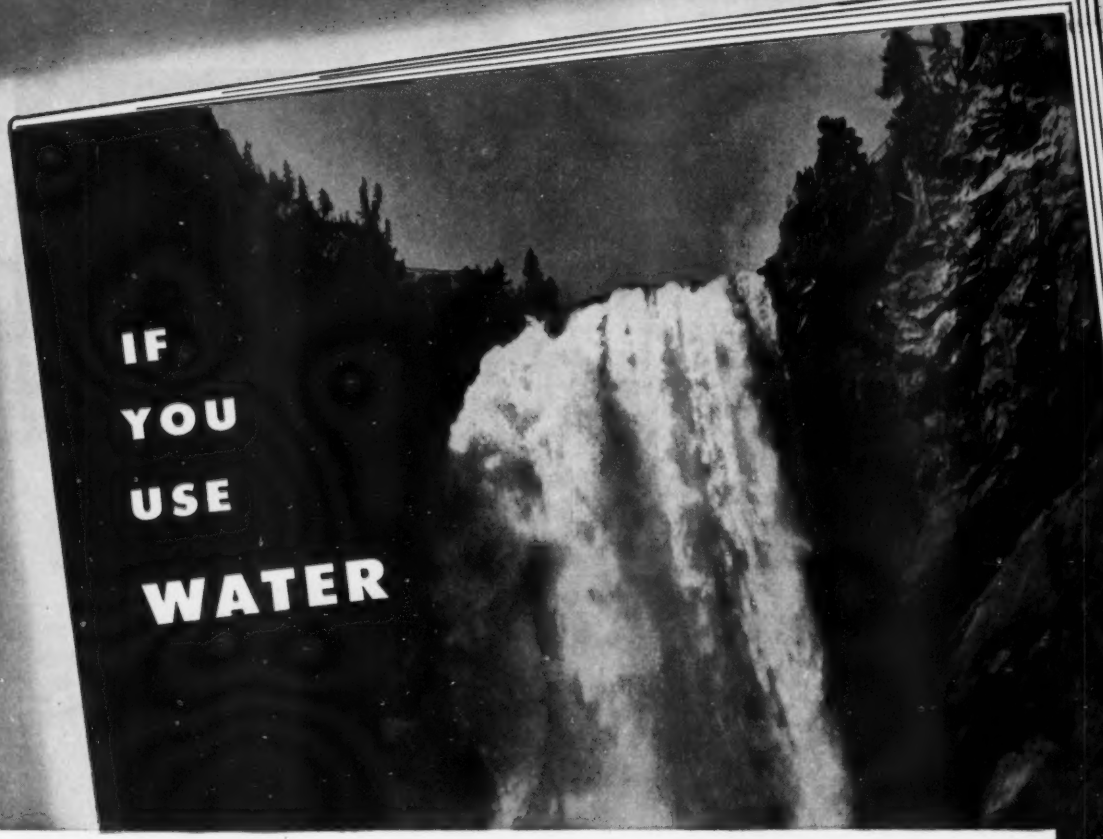
A 200 ton crane with two 100 ton hooks is adequate to handle all loads including large transformers. Alternate hatchways between machines are left clear to serve as areas for any transformer work that may be necessary. Both railway track and truck loads are brought to a point underneath the crane.

There is a single electrical control room on main floor. Within this room are concentrated electrical controls for all generators and transmission circuits leading from plant.

First three turbo-generators are 3600-rpm, single-shaft, triple-flow 1800 psig and 1050 degrees with single reheat to 1000 degrees. Excitation is 375 volts with exciters gear-driven from main shaft. The generators have a name plate rating of 100,000 kw at ½ pound hydrogen and 80 percent pf. Top rating with 30 pounds hydrogen is 156,250 kva.

Each generator has an excitation cu-

Directions for ordering papers on p 160



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Prepared by Rohm & Haas Company ion exchange specialists, "If You Use Water" shows you the way to decreased cost and increased quality of water treatment. In addition, it tells you about the use of the AMBERLITE ion exchange resins in research, medical therapy, air conditioning, television tube manufacture, food processing, printing, electroplating, and other important fields.

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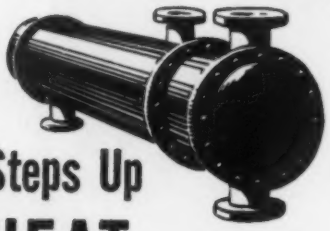

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More TECHNICAL BRIEFS

Begins on page 158

bicle in the electric house. This cubicle contains selector field breakers, rheostats, rotating voltage regulator, a field temperature indicator and transmitter, a transductor for remote indication of field current and field ground detecting equipment. There is a spare motor driven exciter.

Electrical facilities at Eastlake from generator terminals to existing transmission lines 2½ miles away cost less than ten dollars per kw net capability. No other extension of the transmission system is required for this increase of 30 percent in system generating capacity. *AIEE Conference Paper, No Number.*

Directions for ordering papers on p 160

Glenwood No. 3 Outdoor Power Station. *By E F DeTurk, Member AIEE and W J Burns, Nonmember AIEE, Long Island Lighting Company, Garden City, N. Y.*

Long Island Lighting Company placed in service in November 1952 an outdoor 90/99 mn turbine generator unit at Glenwood Power Station No. 3. This unit is first of three similar units planned which will almost double the installed capacity of the system by the end of 1954. Two of these machines are located in a new station at Glenwood Landing on north shore of Long Island and a third in a new plant at Far Rockaway on south shore.

The Glenwood plant, designated as Station No. 3, has been built on the site of an original station, known as Station No. 1 which has been torn down. This new plant supplements three units totaling 185,000 kilowatts in an adjoining plant known as Station No. 2.

The new station incorporates following features:

(1) Turbine generator is of outdoor type, first to be installed in Northeastern part of United States; (2) turbine generator unit is among first 90/99 my standard machines purchased and placed in service anywhere; (3) power station is one of few in country designed and built with complete facilities to burn three fuels, coal, oil and natural gas, interchangeably or simultaneously; (4) all instruments and controls essential to operation are contained in a central location, reducing operating force to a total personnel of four per shift; (5) steam generator is of semi-outdoor type with air heaters, dust collectors and induced draft fans outdoors; (6) both mechanical and electrostatic dust collectors are used in series; (7) design has minimized requirements for anti-freeze protection of air, steam and water lines; (8) no deaerator has been in-

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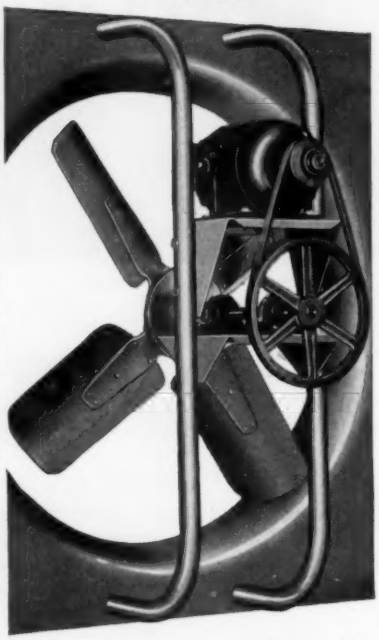

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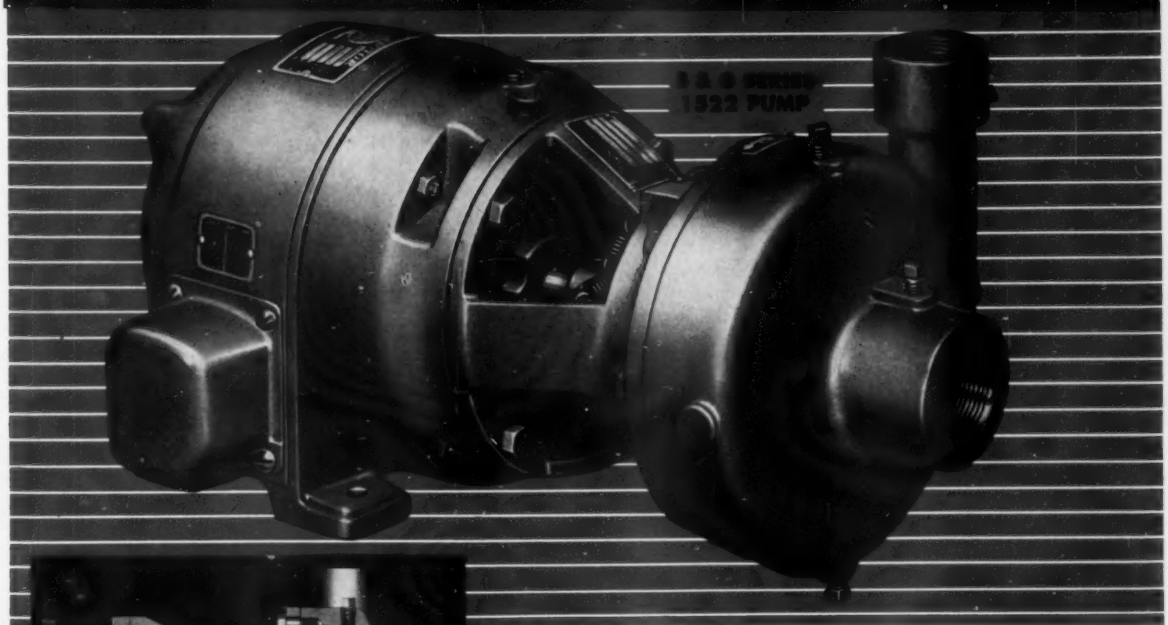
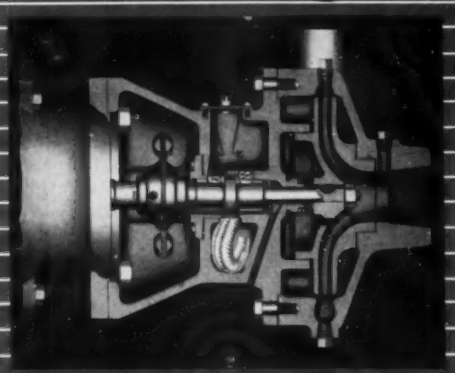
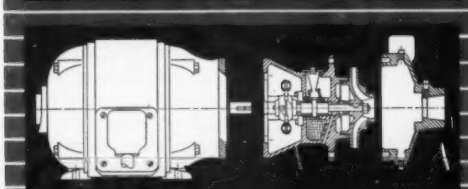
SEE THE 8 REASONS WHY B & G SERIES 1522 PUMP DOES A BETTER JOB







By removing a few bolts, the B & G Series 1522 separates into three parts—easy to service.

When you check into these design features, it's easy to understand why B & G Series 1522 Pumps are making performance records...

First: Leak-proof Mechanical Seal—ends stuffing box troubles.

Second: Spring-type flexible coupling—contributes to unusually quiet operation.

Third: Dynamically balanced impeller.

Fourth: Easily serviced. Removal of a few bolts permits separation into three parts.

Fifth: Interchangeable parts. The bearing bracket sub-assembly, including shaft and sleeve bearings, is manufactured to close tolerances and is interchangeable in all B & G 1522 Pumps.

Sixth: Shaft alignment maintained by oil-lubricated, high grade bronze sleeve bearings.

Seventh: Standard motors—easily obtainable from motor manufacturer's stocks.

Eighth: With all these features, B & G Pumps are *competitively priced!*

Don't delay—get the facts *now* on B & G Centrifugal Pumps.

B & G Series 1531
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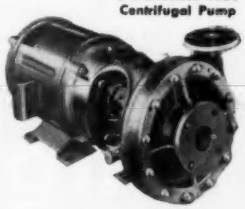

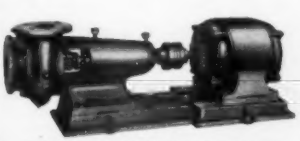

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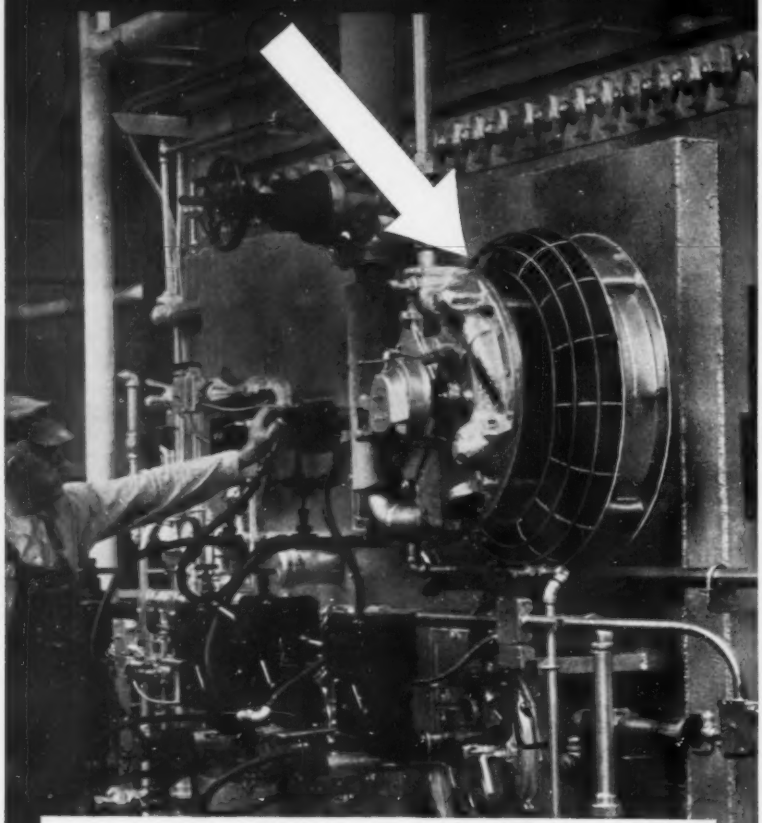
Only a WING Axial Flow Turbine Blower would permit such a compact installation



THIS neat, compact forced draft installation shows how the WING Axial Flow Turbine Blower can save thousands of dollars in installation costs by eliminating the duct work and excavation costs attendant on the use of other types of blowers. This compact, quiet, low-speed blower delivers 11,300 CFM at 3" static pressure to the 40,000 lb. per hr. B & W oil-fired boiler at the Chicago plant of Southern Cotton Oil Co., makers of the well-known Wesson Oil. This is the third Wing blower at the Chicago plant, the tenth in all Southern Cotton Oil plants, the first having been installed in 1916.

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Factories:
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More TECHNICAL BRIEFS

Begins on page 158

stalled, removal of gases from feedwater being done in main condenser; (9) ample space for operation and maintenance has been provided despite space limitation imposed by restricted plant area; (10) coal dust nuisance has been minimized, and (11) output from main generator is carried by an eleven mile long pipe type 69-kv underground cable to substation at approximately load center of system.

Station building, comprising outdoor turbine bay, enclosed auxiliary bay, pulverizer and bunker bay and semi-outdoor boiler section, is a steel framed structure with transite and brick exterior walls and reinforced concrete floors and roofs. Transite has been used above bunker elevation for contrast and also at enclosed elevations of steam generator. Interior walls are face brick except in areas where sanitary or cleaning maintenance justified use of structural glazed tile.

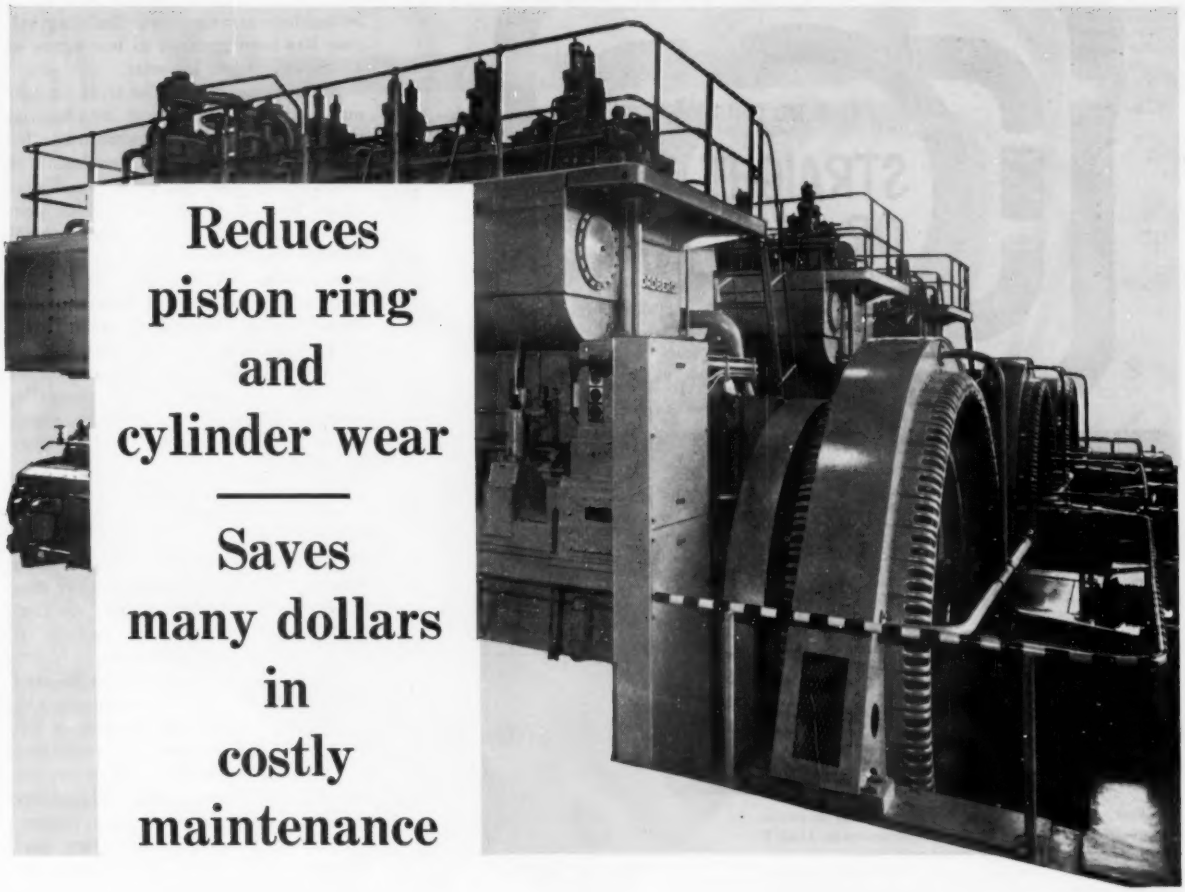
Circulating water pumping costs determined choice of basement-type design for turbine section, with pulverizer bay being maintained at grade. Plant layout was restricted both in depth and width. It was necessary to locate stack close to building and reduce width of turbine bay to a minimum to make arrangement as compact as possible. Some freedom of movement both inside and around exterior of plant was sacrificed. However, adequate space was left for operating and maintaining the equipment.

There is no railroad siding into plant property. Heavy items such as the generator stator and main transformer have been delivered by lighter to the bulkhead.

Decisions to utilize a semi-outdoor steam generator and outdoor boiler plant auxiliaries and to delete the turbine room enclosure have been predicated both upon economics and preferences of Operating Department. In view of substantial investment savings that could be realized, operators have been decidedly favorable to outdoor design. Inconveniences of operating and maintaining facilities during limited periods of inclement weather are more than offset by greater comfort afforded by working outdoors, unhampered by hot confining enclosures, during most of the year. Furthermore, with system peak occurring around Christmas it is possible to schedule regular maintenance during periods of favorable weather. This arrangement coupled with use of centralized controls makes it unnecessary for operators to go outdoors except for routine inspections and infrequent emergency conditions.

Savings have been effected by reduced building construction and forced venti-

Shell Rotella Oil



Reduces piston ring and cylinder wear

Saves many dollars in costly maintenance

These dual-fuel engines in the Municipal Power Plant at Houma, Louisiana, supply dependable, low-cost electric power to the entire city. Shell Rotella Oil is the cylinder lubricant.

Here's just one of the many diesel power plants that depend on SHELL ROTELLA OIL for reduced wear of engine parts . . . lower maintenance cost.

The anti-corrosive action in Shell Rotella Oil combats the major cause of engine wear . . . cylinder and piston ring wear caused by acid action from the by-products of incomplete combustion and condensation.

Tougher lubricating film in Shell Rotella Oil gives cylinders and rings greater protection . . . minimizes wear. Its effective detergent-dispersant action prevents harmful deposits.

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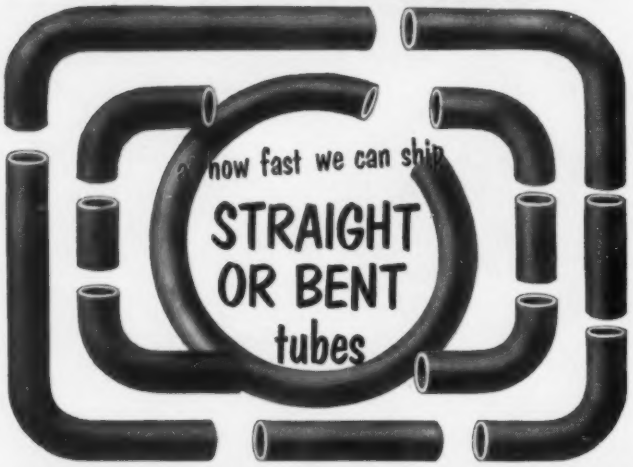

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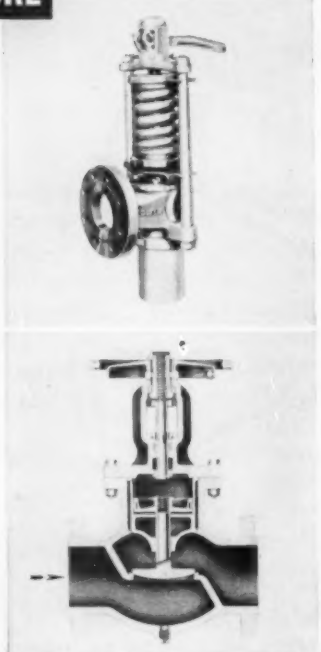

• Foster Type 38-SV Super-Jet Safety Valves for steam pressures to 3000 P.S.I. and temperatures to 1100°F are designed for boiler drum and superheater outlets, reheater inlet and outlets, and, as a relief or safety valve on soot blower installations, turbines, pressure reducing valve and desuperheater stations.

Foster Super-Jet Safety Valves are protecting boilers at 2700 P.S.I. and 1100°F, and are also in service at pressures as low as 10 P.S.I.

Foster Super-Jet Safety Valves have been selected because of their high relieving capacity, adjustability for minimum blow-down, and consistent popping at name-plate pressure. The outside frame rod construction makes disassembly possible without disturbing spring setting, permitting inspection and relapping of seats during a minimum outage time. Piston freedom can be checked at any time with the valve under pressure.

• Foster Automatic Non-Return Valves Type 2C are available for 250 P.S.I. and 475°F; Type 2S for pressures to 900 P.S.I. and temperatures to 900°F.

Designed to prevent a backflow of steam to a disabled boiler, piston assembly assures positive factor of safety. Main valve and seat rings are designed to permit full free flow of steam when the valve is in operation.

Foster Non-Return Valves have been in service since 1900 and today are installed in major steam plants throughout the country.

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More TECHNICAL BRIEFS

Begins on page 158

lation. Cost of weatherproofing turbine generator and outdoor piping have been relatively minor compared with overall reduction in capital expenditure. It is estimated that $300,000 has been saved by outdoor arrangement. Building volume has been reduced to low figure of 11 cubic feet per kilowatt.

Initially, factor of noise from outdoor machine was considered a potential problem and provisions were made for erection of a permanent enclosure if required. It now has been found that sound level in vicinity of turbine generator is less than in a conventional turbine room where sound is reflected from walls. Observations have been made at points at various distances from installation and noise level has not been found objectionable anywhere.

Future plants now in planning stages will follow Glenwood pattern generally, incorporating additional experience with the outdoor construction. *AIEE Paper No. 53-406.*

Directions for ordering papers on p 160

Evaluation of Test Data in Determining Minimum Design Requirements for Aluminum to Copper Connectors. *By D C Hubbard, R W Kunkle, and A D Chance; all of A D Chance Co.*

A four-year research project devoted to problems of copper to aluminum and aluminum to aluminum connectors under normal and extreme field conditions is described in this paper. It shows the extent to which corrosive and contact problems were explored, what preventive action promised satisfactory performance and what precautions are required in their application.

Tests from which conclusions are drawn were continued to point of failure of joint, or to point of approaching failure of control specimens whose field performance is known and considered satisfactory. Resistance to corrosion, both sea-coast and industrial, as well as electrical and mechanical performance, was taken into consideration. Following observations are based on data collected from laboratory tests on 240 specimens, field tests, user's experience and studies made by other organizations:

(1) Joints, whether copper or aluminum, must be clean and free of oxide and sulphurous films. Aluminum conductors and unplated aluminum connectors, whether discolored or not, must be scratched-brushed, preferably under a film of anti-corrosion compound immediately before joint is made up. New copper alloys and plated connectors may be used as received from stock, without special cleaning.

(2) Test joints maintained lower tem-

Those MARLEY fans sure move a lot of air!

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... that's because Marley multi-blade aluminum fans are engineered specially for cooling tower application—specifically, for Marley cooling towers. The true air foil blade design, based on years of research and wind tunnel testing, was selected as the most efficient for the range in air velocities and pressures found in various types of cooling towers. The twist and taper of the wide, sturdy blade is designed to provide constant velocity from hub to tip. By using six to twelve blades, depending upon fan diameter, Marley fans operate more smoothly and quietly.

Another reason Marley fans move a lot of air is that they operate in Marley Laminated Fan Cylinders, developed to complement the performance of this particular fan. Marley fans, air delivery cylinders and Geareducers are engineered as complete functional units, assuring the balance necessary to attain top fan efficiency.

Durability and strength are important, too. These are achieved by utilizing the newest casting techniques and an aluminum alloy selected for its castability, strength and corrosion resistance. Every dimension from shank to tip is more than ample for any operating load encountered.

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More TECHNICAL BRIEFS

Begins on page 158

perature performance when copper conductors replaced one or both aluminum conductors. This was attributed to greater thermal conductance of copper.

(3) Where conductors are under tension or subjected to electromagnetic forces, longer service life can be expected where conductor and its plating are of material that will not galvanically attack the conductor.

(4) Both copper-alloy and aluminum-alloy connectors proved satisfactory where design had adequate resilient takeup. This is achieved by using clamps of proper section and making use of elastic range of bolt material. Initial clamping forces may cold-flow conductor or clamp as line or point contacts are flattened into areas or as strands are deformed.

(5) Copper alloy bolts in general purpose connectors attack aluminum conductors where space between bolts and connectors was bridged by foreign matter contaminated by an electrolyte. Joint compounds helped to avoid this.

(6) Joint loosening can be a result of corrosion. Reduction of aluminum members, whether conductor or clamp material, is appreciable where severe galvanic action is permitted. In some tests, failure by loss of clamping pressure due to erosion was demonstrated. In absence of corrosion-inhibiting compounds, heavy fortified cadmium plating on both copper- and aluminum-alloy connectors joining copper and aluminum conductors outlasted all other plating combinations tested without evidence of joint loosening.

(7) Heavy fortified cadmium plate on either aluminum or copper alloy connectors and heavy-hot-flowed electro-tin-plate on copper-alloy connectors with suitable corrosive-resistant compounds appear to be satisfactory when connectors are applied as recommended by manufacturer.

(8) Heavy, hot-flowed tin and heavy fortified cadmium plating exhibited superior performance over bimetal washers 0.30 in. thick.

(9) These platings also demonstrate improvement over copper liners soldered to aluminum bodies.

(10) Anti-corrosion aids are effective in prolonging joint life for both cadmium and tin coatings.

(11) Where corrosion-inhibiting compounds are omitted, cadmium offers greater margin of safety in contact with aluminum.

(12) In severely corrosive areas, heavy fortified cadmium plate on aluminum body connectors offers greater margin of

Directions for ordering papers on p 160

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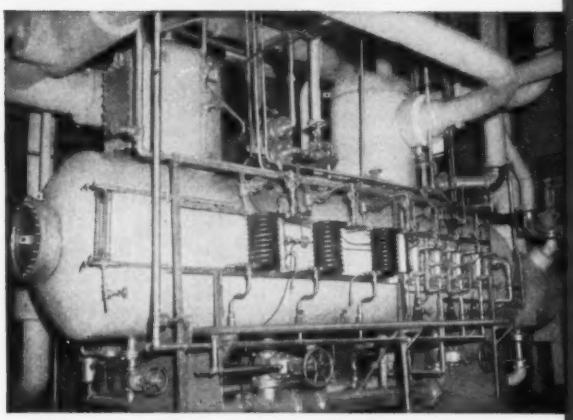
10 Aircooled Heat Exchangers
11 Prefabricated Pipe
12 Propane Storage Tanks
13 Large Diameter Water Lines
14 Penstocks



For Example—ALCO Flex-Tube Evaporators have a positive-acting, thermomechanical descaling action.

Making use of this principle, engineers designed a patented arrangement of struts, tension bars and split support plates. The tubes bend or flex when heat is applied to the coil side. When cold water is sprayed over the tube bundle, the tubes contract, and scale cracks off and is flushed away through blowdown openings.

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SMALL SEPARATE REMOVABLE CHANNEL AND COVER eases job of maintenance men.

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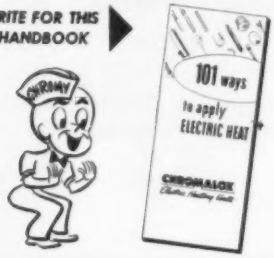

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More TECHNICAL BRIEFS

Begins on page 158

protection to aluminum conductor. Anti-corrosion compounds should be applied to prevent copper washers of aluminum to copper connections from attacking aluminum washers.

(13) Heavy fortified cadmium applied over aluminum alloys with proper base and surface treatment has several advantages over other combinations. *AIEE Paper No. 54-39.*

More POWER NEWS

Begins on page 156

Coming Events

April 21-23—1954 Southern Industrial Wastes Conference, Shamrock Hotel, Houston, Texas. For details write J D Kettelton, Mfg Chemists' Assn, Inc, 1625 Eye St, NW, Washington 6, D. C.

May 3-6—Air Pollution Control Assn, annual meeting, Patten Hotel, Chattanooga, Tenn. For details write H C Ballman, exec secy, APCA, 4400 Fifth Ave, Pittsburgh 13, Pa.

May 5-7—American Institute of Electrical Engineers, Northeastern district meeting, Hotel Van Curler, Schenectady, N. Y. For details write AIEE, 33 W 39th St, New York 18, N. Y.

June 13-18—American Society for Testing Materials, annual meeting, Sherman and Morrison Hotels, Chicago, Ill. For details write ASTM, 1916 Race St, Philadelphia 3, Pa.

July 13-15—Plant Maintenance Show and **Plant Maintenance Conference,** Pan Pacific Auditorium, Los Angeles, Calif. For details write Clapp & Poliak, Inc, 341 Madison Ave, New York, N. Y.

Sept 28-Oct 1—1954 Iron & Steel Expostion, Cleveland Public Auditorium, Cleveland, Ohio. For details write AISE, 1010 Empire Bldg, Pittsburgh 22, Pa.

Oct 4-6—National Electronics Conference, Hotel Sherman, Chicago, Ill. For details write R E Hornacek, Illinois Bell Telephone Co, 208 W Washington St, Chicago 6, Ill.

Oct 22-23—Institute of Power Engineers, annual convention, Windsor, Ontario. For details write W G Child, IPE, 410 Bloor St East, Toronto 5, Canada.

Australia plans billion-dollar hydroelectric project

HERMAN F BAHMEIER, 40-year veteran in water engineering, leads a team of six Bureau of Reclamation engineers who are beginning two-year assignments

8 MURCO Spillway Gate Hoists, 125 ton capacity, installed by the Washington Water Power Co., Cabinet Gorge Project, Clark Fork River, Idaho.

Murray Gate Hoists are designed and built in a wide range of capacities from less than one ton to over one hundred tons . . . from the smallest hand operated to the largest motor operated gate hoist. In over 50 years of designing and building gate hoists, we have developed designs for many gate hoist problems. We may have designs and patterns to fit your special requirements. In planning gates or gate hoists, we suggest you write us before your over-all plans are complete . . . it may save time and money. We also build gate hoists to fit your plans and specifications.

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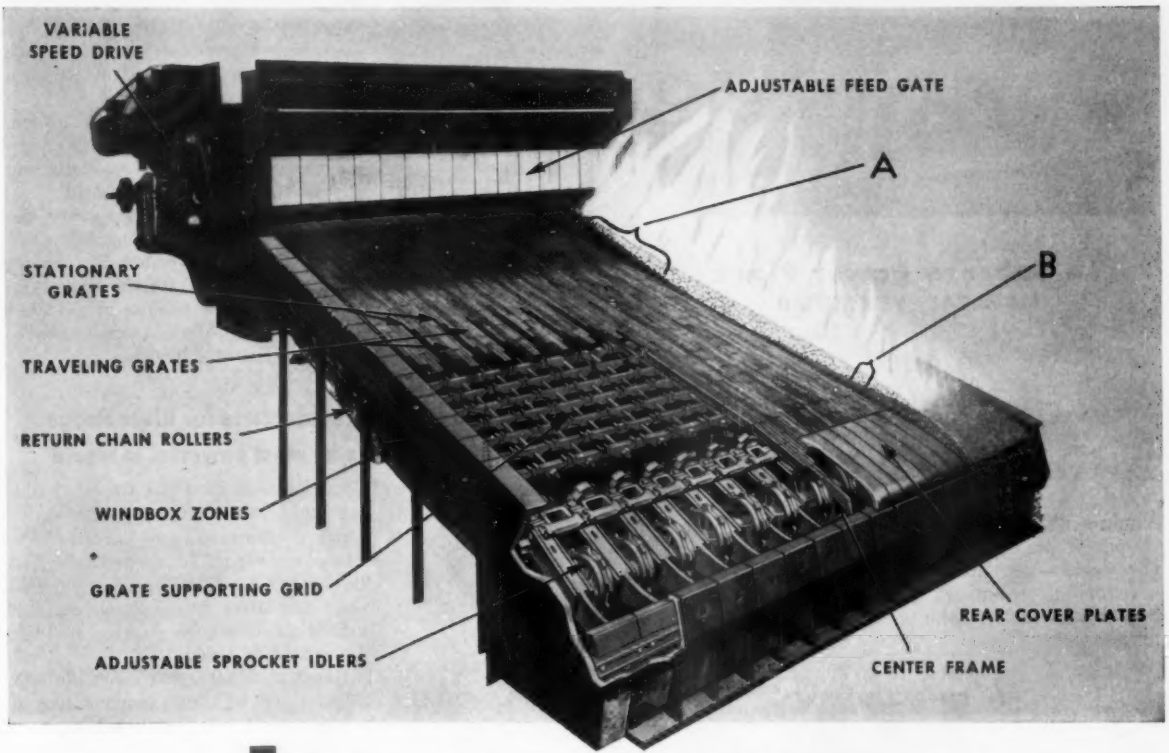

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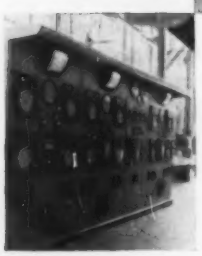

ENGINEERING: Preliminary studies and designs by detailed working drawings and specifications. (Services of resident engineer optional.)

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More POWER NEWS

Begins on page 156

in Australia to advise the Commonwealth government on first construction stages of the tremendous Snowy Mountains hydro project.

By the end of March, the six men will be on field duty at Cooma and Cabrumurra, New South Wales, near the locations of Adaminaby Tunnel (14 miles long, 21 ft in dia), Tumut Pond Dam (concrete arch 300 ft high) and T-1 Power Station (320,000 kw installed capacity).

These works will cost more than $100-million and are the forerunners in a series of water-use structures in a 20-year plan that will exceed $1-billion. This is the largest civil works undertaking ever launched by Australia and is one of the largest in the world.

Bids on the tunnel, dam, power station, and a 2-mile power tunnel opened at Sydney last November 30. Snowy Mountains Hydro Authority expects to make awards soon to some of the large number of Australian, American, European and Oriental bidders.

Transformers for River Rouge to be most powerful in world

Westinghouse Electric Corp is building the world's two most powerful transformers, each capable of handling electric power needed by a city the size of Baltimore. Designed for Detroit Edison's new River Rouge Plant, the first unit is scheduled for shipping in 1955, the second in 1956.

Rated at 315,000 kva each, the new transformers will boost power output of a generator from 17,300 to 129,000 v, thus permitting economic power distribution to distant points. The most powerful transformers previously built were four 190,000-kva units that Westinghouse developed for Detroit Edison's St Clair station.

Although the two new units are considerably more powerful than any that have been built to date, they will be only slightly larger in physical size as a result of recent advancements in design. Cooling will be accomplished by means of forced circulation of oil or air.

Dalmine, SpA of Milan, Italy has appointed Charles A Koons & Co of 620 Fifth Ave, New York exclusive American agents for its products. Dalmine, one of the largest seamless steel producers in the world, has plants in Apuania, Dalmine and Naples. Products include a complete line of casing, tubing and line pipe for oil and gas industries and a variety of hot and cold-drawn tubing. It also produces carbon, alloy and stainless tubular products to all American specifications including those of ASTM and API.

WELDOLET AND THREDOLET PERFORMANCE IS PRE-PROVED BY TESTING

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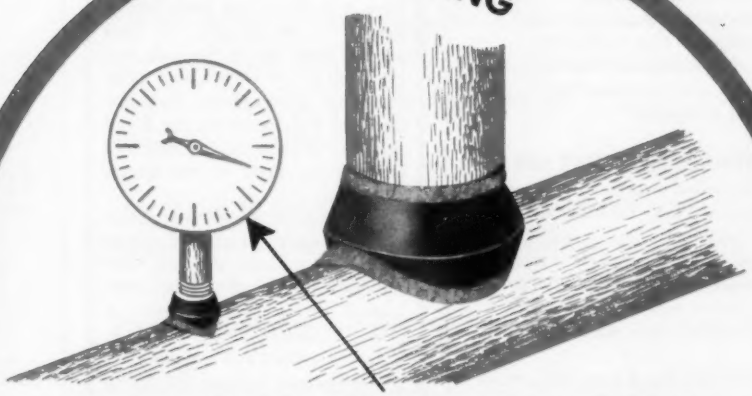
Butt-welding

Socket WeldOlets

ThredOlets



SPECIFY AND USE WELDOLETS AND THREDOLETS

Their predetermined performance standards are your guarantee of permanent piping. WeldOlet and ThredOlet design and performance are backed by Bursting Tests in accordance with A.S.A. B16.9 Code for Welding Fittings.

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CHECK THESE 5 NEW WAYS TO CUT COSTS

☐ **USE LESS LUBRICANT —**
One Ohio mill stamping manufacturer says: "We are using ⅓ less lubricant with PLASTILUBE than previously, thus cutting our costs and giving us the added protection we are looking for."

☐ **STOP NEEDLESS WEAR —**
A famous aircraft company did by using PLASTILUBE to retard spline wear on engines. Enthusiastic engineers say PLASTILUBE prevents fretting corrosion of dry spots and galling of highly-stressed surfaces.

☐ **INCREASE PRODUCTION —**
A Minnesota flour mill boosted weekly production by 500 bags, found lubrication cycle stretched from every 3 hours to every 3 days!

☐ **SAVE MAN HOURS —**
Leading dock company now standardizes on PLASTILUBE because, "maintenance time is reduced 60% on most of our heavy loading and unloading equipment."

☐ **STRETCH EQUIPMENT LIFE —**
Intensive tests by one power plant proved PLASTILUBE lasts under high speed, climatic and moisture changes. It remained normal, was reused after 8-month run on a Coppus steam turbine pump. Bearings showed no wear, were reinstalled.

Check these and many other ways to cut costs with multi-purpose PLASTILUBE. Warren engineers will be glad to show how this great lubrication development can save men, money, and material in your plant!

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Please send me full details on PLASTILUBE.

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My Biggest Boner

► SHORTLY AFTER I'd started my job as chief engineer of an institutional plant, some of the ground-floor plumbing went bad.

"Better let me handle it, boss," the plumber volunteered, "it's one of those tricky jobs."

Here, I thought, was a good opportunity to show both management and crew the stuff their new chief was made of. So I grabbed a monkey wrench and flashlight and struggled into the crawl-space beneath the building with the trouble.

The shutoff was a stopcock that refused to budge—a small problem for a sharp chief like me. I gave it a sharp rap from underneath. To my surprise the plug popped right out of the body and a torrent of icy water came gushing down on top of me. In a moment the light went out and I was skidding around in the mud and banging my head on the beams above.

After I'd slithered away from the icy shower, I breathed a little easier. I could see the exit. But suddenly a pair of blazing eyes loomed up in front of me. A skunk! I finally got out—screaming and smelling and waving wildly for someone to have the utility cut off the water.

Later, I learned that the retaining nut and washer had been removed from the plug. If I'd only looked before rapping it with the wrench, everything would have been all right. The next time I have a problem, I'm going to spend a little less time telling myself how easily I can solve it, and more time figuring it out.

M A Jensen LINCOLN, NEB.

● What is your "biggest boner"? We'll pay ten dollars for each one we publish.

Why I keep 2 spare gauge glasses

For top boiler safety, the experts tell me never to put the same glass into a gauge after I've had it apart.

That's why I always keep *one* spare around. The other one? Well, I like to feel that, if someone should accidentally break a gauge, I've got another one all ready to go into place, without losing any valuable time.

In football, they call it "depth." In boiler maintenance, they call it smart planning. And for the few cents it costs to buy two spares, I get rid of a bothersome replacement problem.

* * *

Why don't *you* give yourself that confidence? Call your industrial distributor and order *two* spares for every boiler in your plant. Of course, you'll want PYREX brand gauge glasses —safest on the market, because of strong, heat-resistant construction. They're easier to read, too, because their chemical stability resists corrosion by steam, keeps glass fog-free longer.

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Application	*Recommended Product*
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
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What the

BIG TRUTH*

and

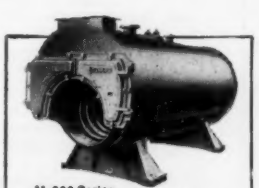
KEWANEE reserve plus rating

mean to the engineer . . .

■ Once in a great, great while an industry announcement has significance far beyond the usual. We at Kewanee-Ross believe the Big Truth about boilers and Kewanee Reserve Plus rating to be one of the most important precepts of business we ever presented.

Kewanee Reserve Plus rating *guarantees* dependability, flexibility, higher efficiency, lower costs, longer boiler life because it means "cruising speed" operation. So when you consider boilers, remember the Big Truth . . . ***"*the only safe way to select boilers is on nominal capacity to operate at 'cruising speed'."***

Kewanee Reserve Plus means boiler selection is made with confidence, guesswork is eliminated . . . the most economically sound expenditure is guaranteed . . . protection against emergencies and fluctuating loads, provision for expansion are provided . . . lower boiler maintenance and lower operating costs are assured.



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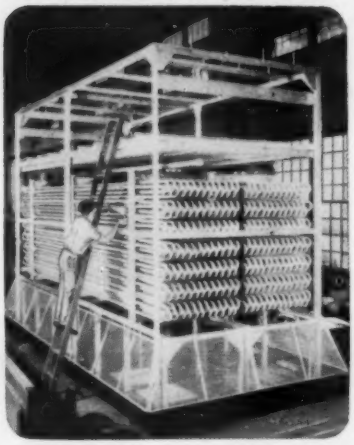

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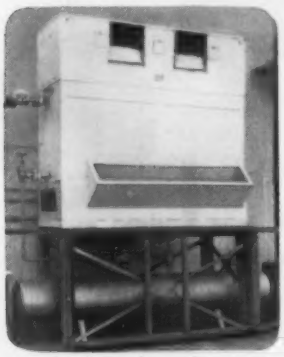

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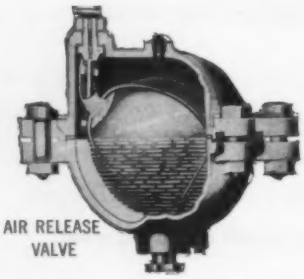

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a BIG trouble-saver that costs you LITTLE!

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densities. Construction and standardization characteristics, details of operation Booklet B-6134. Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30, Pa.

17 **Steel mill drive** engineering. Fully illustrated, 16-page publication. Bulletin GEA-6034, General Electric Co, Schenectady 5, N. Y.

18 **Emergency auxiliary** lighting equipment. Four-page pamphlet designed to help in selection of UL-approved equipment. Form 4808, Electric Storage Battery Co, Box 8109, Philadelphia 1, Pa.

HEAT EXCHANGERS

19 **Heat transfer** equipment for various industrial applications. Two-color, fully illustrated, 16-page brochure. Bulletin 1000, Davis Engrg Corp, 1064 E Grand St, Elizabeth 4, N. J.

20 **Industrial oil and gas** burner equipment. Two-color, 28-page booklet. Photos, dimensional sketches, exploded views, full specs. Bulletin OB-53, The Engineer Co, 75 West St, New York 6, N. Y.

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INSULATION

22 **Gilsulate insulation** for protection of hot underground pipes. Illustrated, 20-page tech data manual. Charts, tables, drawings, full specs. American Gilsonite Co, 134 W Broadway, Salt Lake City, Utah.

23 **Protective qualities** of neoprene in applications affected by sunlight, heat, abrasion, cold and various chemicals. Metalweld, Inc, Protective Coatings Div, Scotts Lane & Abbottsford Ave, Philadelphia, Pa.

MAINTENANCE EQUIPMENT

24 **Filters and purifiers** for oil-circulating systems. Sixteen-page article in March 1954 issue of magazine, *Lubrication.* Photos, cutaway views, diagrammatic sketches, charts and graphs. The Texas Co, 135 E 42nd St, New York 17, N. Y.

25 **Constant and variable** supports and standard hanger assemblies. Fully-illustrated, 48-page manual. Complete specs. Catalog 531, Bergen Pipesupport Corp, New York, N. Y.

26 **Shock and vibration** isolators for wide variety of industrial applications. Two-color, 4-page folder with illustrations and full specs. Bulletin 538, The Barry Corp, 855 Pleasant St, Watertown 72, Mass.

27 **Steel reinforced** flooring for interior or exterior surfaces of concrete or wood. Two-color bulletin. United Laboratories, Inc, 16801 Euclid Ave, Cleveland 12, Ohio.

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30 **Electric hoists** for maximum efficiency with speed, safety and durability. Two-color, six-page folder. Photos, cutaways, full specs. Bulletin QL, Coffing Hoist Co, Danville, Illinois.

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31 **Replaceable-face** electric brakes and stationary-field electric

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All replies will be held as a strict confidence.

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Begins on page 171

clutches. Two-color, six-page, illustrated brochure. Bulletin 6158, Warner Electric Brake & Clutch Co, Beloit, Wis.

32 **Engineering handbook** on elevator belting. 24-page booklet with application photos, charts, tables and complete specs. The B F Goodrich Co, Akron, Ohio.

METALS & ALLOYS

33 **Meehanite castings** for pressure tightness. Fully illustrated, 48-page booklet. Complete specs and engrg data. Bulletin 43, Meehanite Metal Corp, 714 North Ave, New Rochelle, N. Y.

34 **Slide chart** giving facts on steel casting material selection. Lebanon Steel Foundry, 199 Lehman St, Lebanon, Pa.

35 **Suggestions** for proper selection of tools for wide variety of metal cutting operations. Illustrated, 28-page, pocket-size guide. Victor Saw Works, Inc, Middletown, N. Y.

METERS & INSTRUMENTS

36 **Low-head type** differential-pressure pneumatic transmitter for measuring liquid fuels and for automatic control of fuel-air ratio. Full-color, 4-page folder. Bulletin 2753, Hagan Corp, Pittsburgh 30, Pa.

37 **Complete line** of instruments for industrial process control applications. Fully illustrated, 4-page folder. Bulletin F5633-1, Barber-Colman Co, Wheelco Instr Div, Rockford, Ill.

38 **Portable high-current** test instruments. Two-color, fully illustrated, 4-page folder. Catalog MA-154, Multi-Amp Corp, 10 Third St, Newark, N. J.

39 **Dynamometer systems** for testing internal combustion engines, transmissions, torque converters, rear axle assemblies, pumps, fans, electric motors, compressors and other types of equipment. Two-color, 12-page, illustrated booklet. Bulletin GEA-5923, General Electric Co, Schenectady 5, N. Y.

40 **Automatic bin-level** indicator for all bulk materials. Fully illustrated, 20-page booklet. January 1954 catalog, Bin-Dicator Co, 13946 Kercheval Ave, Detroit 15, Mich.

PIPING, VALVES, FITTINGS

41 **Temperature and pressure** relief valves. Illustrated, 26-page handbook telling what these valves are and how to use them. Bulletin 297, A W Cash Valve Mfg Corp, Decatur, Ill.

42 **Solenoid valves** and electromagnetic controls. Two-color, illustrated folder summarizing company's full line of equipment. Circular VS-50, Automatic Switch Co, 391 Lakeside Ave, Orange, N. J.

43 **Steam-jacketed** valves for the handling of viscous materials. Two-color, 4-page, fully illustrated folder. Bulletin E200, Everlasting Valve Co, 45A Fisk St, Jersey City 5, N. J.

44 **Center-guided** check valves. Two-color, 4-page folder. Installation photos, full specs. Bulletin 153, Miller Valve Co, Inc, PO Box 1255, Pittsburgh 30, Pa.

45 **Stainless steel** safety and relief valves for liquid and vapor service. Fully illustrated, 4-page folder. Associated Valve & Engrg Co, 1150 W Marquette Rd, Chicago 21, Ill.

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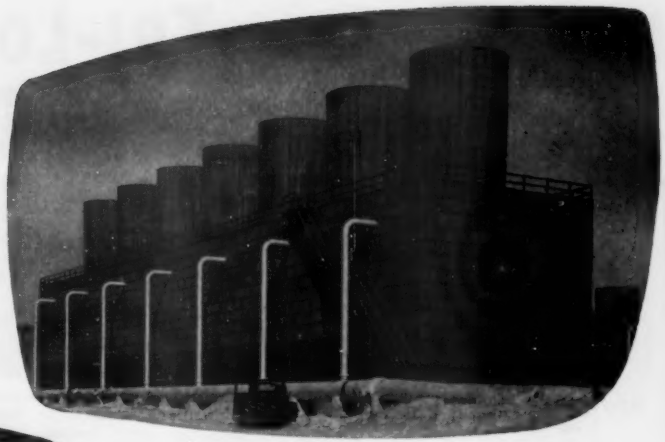
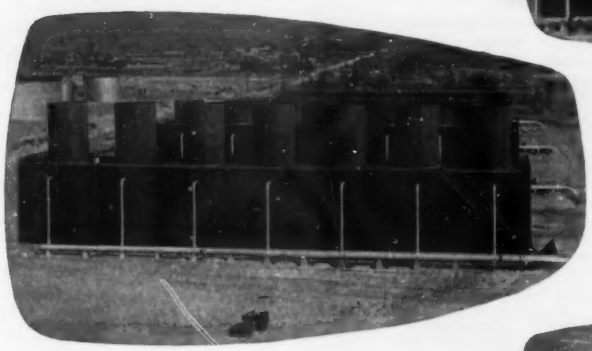
46 **Generators** for diesel power station applications covering extremely wide size range. Two-color, 25-page booklet. Photos, installation and operation sketches, dimensional sketches, performance curves, full specs. Allgemeine Elektricitats-Gesellschaft, Berlin, Germany.

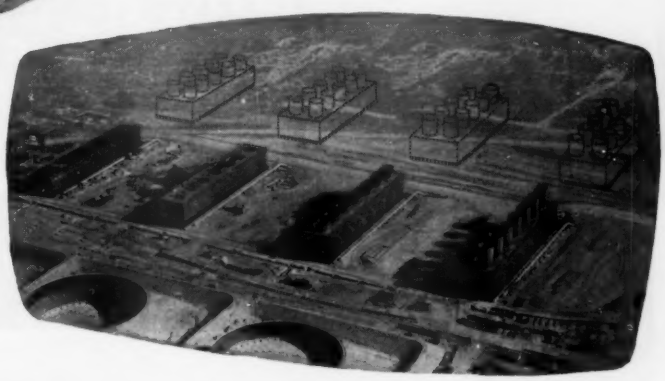
47 **Flexible metal hose** for marine and industrial diesel applications.

FLUOR *is building the world's largest initial cooling tower installation*





These Fluor Counterflo Cooling Towers are now being erected in the San Fernando Valley at the site of the new 512,000 KW steam-electric generating plant for the Department of Water and Power, City of Los Angeles. They comprise the largest initial cooling water circulating system utilizing cooling towers ever built.



The power plant itself is the largest initial installation inland and is being constructed in two sections. The first section consists of two units of 100,000 KW each, the second section of two units of 156,000 KW each. The four Fluor towers shown here (28 cells) in progressive stages of erection, are designed at 36,000 g.p.m. each, with a maximum of 42,000 g.p.m. They will service the first section of the plant. Design cooling range is 14° F with water entering at a temperature of 95° F and leaving at 81° F. The design wet bulb temperature is 70° F. Heat load is 1 billion B.t.u./Hr. for the first four towers.

Each cooling tower is 250 ft. long, 42 ft. wide and 37.5 ft. high to the fan deck. Twenty-foot, four-bladed fans are driven by 40 H.P. motors. Each fan moves 436,000 CFM. Capacity rating is 144,000 g.p.m. through a low pressure water distributing system. A distinctive feature of these towers is the Fluor-designed redwood stack standing 30 ft. high to minimize recirculation at peak load conditions.

Ground has been broken for the erection of four additional Fluor towers to serve the second section of the plant. Each tower will consist of 5 double-cells for a total of 40, with water circulation of 136,800 g.p.m. Design duty: inlet temperature 101° F, outlet 80° F, wet bulb 70° F. Heat load is 1,440,000,000 B.t.u./Hr. Dimension of these towers: 180 ft. long, 66 ft. wide, 45 ft. high to fan decks. Fans (18 ft.) will be driven by 40 HP motors and each will move approximately 350,000 CFM.

In addition, an auxiliary system (the bearing cooling water) employs a 4-cell Fluor Tower with a heat load of 40 million B.t.u./Hr.

When completed, total cooling water circulation will exceed 280,000 g.p.m. and *will circulate over 240 miles of condenser copper tubing.* Total heat load will approach 2½ billion B.t.u./Hr. The big jobs can be entrusted to Fluor, a firm with 33 years experience in the design and manufacture of cooling towers for every type of service. For complete details on Fluor Cooling Towers, write for the new illustrated bulletin, "Cooling Water for Industry."

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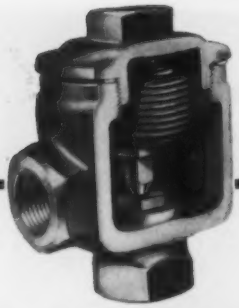

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Begins on page 171

Two-color, 8-page brochure. Photos, installation sketches, full specs. Bulletin EH-50, American Metal Hose Branch of American Brass Co, Waterbury 20, Conn.

48 **Stationary diesel** engines, five models of 9 to 54 bhp and 1 to 6 cylinders. Two-color, 8-page booklet. Photos, dimensional sketches, full specs. Bulletin 5303, National Supply Co, Engine Div, Springfield, Ohio.

PUMPS

49 **End-mounted** regenerative-turbine chemical pumps for corrosive-handling service. Fully illustrated, 20-page booklet. Full specs and engrg data for each model presented. Section 100, Roy E Roth Co, Rock Island, Ill.

50 **PumPak**—new advance in single-shaft centrifugal pump technique. Two-color, 12-page booklet. Installation photos, dimensional sketches, cutaway views, full specs. Bulletin 8901, Sigmund Pumps, Ltd, London & Gateshead, England.

WATER TREATMENT

51 **Causes of condensate** corrosion and methods for stopping it. Two-color, fully illustrated, 4-page folder. Bulletin 35, National Aluminate Corp, 6216 W 66th Pl, Chicago 38, Ill.

52 **Mixed-bed,** 2-bed and 4-bed demineralizers for laboratory, hospital and industrial use. Two-color, 20-page catalog. Photos, application data, full specs. Catalog 127, Barnstead Still & Sterilizer Co, 101 Lanesville Terrace, Forest Hills, Boston 31, Mass.

53 **Demineralization** and principles of ion exchange. 39-page handbook. Design and operation data, operating results, flow diagrams, performance curves for various systems. Bulletin 5800, Cochrane Corp, 17th St below Allegheny Ave, Philadelphia 32, Pa.

54 **Water filters** for either sump or line installation in 8 individual size units from 5 to 100 gpm. Water Filter Catalog No. 300, Marvel Engrg Co, 625 W Jackson Blvd, Chicago 6, Ill.

55 **Ion-exchange** industrial water softeners. Two-color, 8-page booklet. Photos, cutaway views, complete specs. Form No. S-105, Illinois Water Treatment Co, 891 Cedar St, Rockford, Ill.

MISCELLANEOUS

56 **Car shakers** for the unloading of bulk materials such as coal, cinders, gravel, etc. Two-color, six-page, illustrated folder. National Conveyor & Supply Co, 352 N Harding Ave, Chicago 24, Ill.

57 **Compilation** of ASTM papers entitled, *Some Unsolved Problems* and intended to stimulate studies of those properties of materials concerning which information is needed. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.

58 **Case histories** for more than 300 types of metal joining operations. 32-page booklet, titled, *DirectoRod Guide*. Photos, selection charts for electrodes and fluxes. Eutectic Welding Alloys Corp, 40-40 172nd St, Flushing, N. Y.

59 **Fluid power pumps,** motors, transmissions, cylinders and valves. Two-color, 12-page booklet. Photos, sectional views, full specs. Bulletin 10051-C, Oilgear Co, West Pierce St, Milwaukee 4, Wis.

60 **Case histories** on the subject of how to get the most out of diesel power. Two-color, 8-page, illus booklet. Caterpillar Tractor Co, Peoria 8, Ill.

61 **Single-stage turbine** for following conditions: hp to 100, pressures to 300 psig, temps to 550 F, speeds to 4000 rpm. Two-color, 6-page leaflet. Design features, dimension and performance data, full specs. Bulletin 4206, De Laval Steam Turbine Co, Trenton 2, N. J.

'SAIRSET

For the past 28 years, 'SAIRSET has been recognized as the finest quality air-setting, high temperature bonding mortar on the market. It forms a thin, airtight joint and bonds all types of firebrick into a one-piece unit at all temperatures. The high refractoriness of 'SAIRSET guards against fusion or softening of the joints ... increasing the service of the firebrick.

A. P. GREEN BONDING MORTARS

ADD EXTRA LIFE AND PROTECTION TO FIREBRICK LININGS . . . REDUCE DOWN-TIME

KD-2

An air-setting, high temperature bonding mortar that will not fuse or soften in the joints. KD-2 develops excellent plasticity and workability immediately on mixing — no long soaking period required. Gives maximum protection because it does not shrink ... there are no cracks for flame and slag to attack. KD-2 is shipped dry and will not freeze, deteriorate or lose its working and bonding characteristics in storage.

DIAMOND-JO

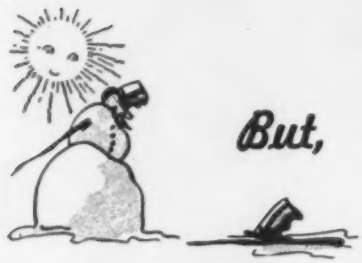
A dry, heat-setting high temperature mortar for laying firebrick. DIAMOND-JO is free from joint shrinkage or expansion . . . provides strong airtight joints at high temperatures ... recommended for temperatures above 2000° F. It is ground extremely fine . . . makes thin brick-to-brick joints.

FOR SPECIFIC RECOMMENDATIONS, without obligation, on your refractory problems or requirements, call your local A. P. Green distributor ... he is listed in the yellow pages of your telephone directory ... or write direct.

A. P. Green REFRACTORY PRODUCTS

A. P. GREEN FIRE BRICK COMPANY
Mexico, Missouri, U. S. A.
In Canada
A. P. GREEN FIRE BRICK COMPANY, LTD.
Toronto 15, Ontario

DISTRIBUTORS IN THE PRINCIPAL CITIES OF THE WORLD



THE BONDING STRENGTH OF

ADAMANT FIRE BRICK CEMENT

INCREASES AS TEMPERATURE RISES!

800 lbs. P.S.I. AT ROOM TEMPERATURE

1270 lbs. P.S.I. AT 2600° F. . . .

Yes, impartial tests prove that the bonding strength of ADAMANT rises from 800 lbs. p.s.i. at room temperature to 1270 pounds at 2600° F.—Actually, ADAMANT is as strong as the brick it bonds. Its strong, gas-tight, metal-tight joints will not shake loose from vibration . . . effectively resist the abrasive action of dust-laden air . . . maintain their bond throughout the temperature range . . . and set without shrinking or cracking. Write or call us for literature and dealer's name.

ADAMANT - ready - mixed and easy to use—available in air-tight drums of 100, 250, and 500 lbs. capacity.

There is an ADAMANT Distributor near you—write us for his address.

BOTFIELD

REFRACTORIES CO.

784 S. Swanson St., Philadelphia 47, Pa. In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto

APPOINTMENTS

Corporation Executive Changes

Texas Eastern Transmission Corp: George T Naff, from executive vice-president to president. **Atlas Mineral Products Co:** Dr Raymond B Seymour, from executive vice-president to president. **C H Sprague & Son Co:** Horace B Holland, president succeeding Richard L Bowditch. **West Penn Power Co:** R W Hurd and D M Kammert, vice-presidents.

New Sales Managers

General Electric Co: Christopher T Kastner, transformer appartus sales. **Graybar Electric Co, Inc:** L A Shaw, Rocky Mount, N. C. branch. **Norton Co:** Donald L Price, abrasive division. **General Dynamics Corp:** Mark L Lane, New York district of Electro Dynamic Division; Harry W Ellis, midwest region of Electro Dynamic Division. **American Flexible Coupling Co:** Hunley A Slaughter, Tennessee and Arkansas district.

New Sales Engineers

Orr & Sembower, Inc: J Frederick Keeler, home office and factory area of central Pa. **Norton Co:** Bruno D Hendrickson, western New York territory. **Powell Valves:** C Barry Neill Jr, Alabama-Georgia-Mississippi region. **American Water Softener Co:** Howard G Egginson, Philadelphia area. **Robertshaw-Fulton Controls Co:** Joseph C McCarthy, Canadian sales; Robert O'Hara, Detroit office.

Recent Purchases

Texas Eastern Production Corp: all stock of Triangle Pipeline Co. **American District Steam Co, Inc:** entire business of California Steel Products Co.

Institute Elections

Air Pollution Control Assn: Harry C Ballman, executive secretary. **Industrial Unit Heating Assn:** I W Clark, president; W G Schlichting, vice-president; G W McCormick, secretary-treasurer. **Heating & Cooling Coil Manufacturers Assn:** P G Kayser, president; W C Jones, vice-president; G W McCormick, secretary-treasurer.

Obituaries

T Barclay Whitson, 59, director of engineering and member of the board for James G Biddle Co, January 23rd. Mr Whitson was a member of American Institute of Electrical Engineers, Franklin Institute, Mineralogical Society of Pennsylvania and the Engineers Cult of Philadelphia.

George F Hessler, 64, vice-president in charge of all sales activities and member of board of directors and of the executive committee of Graybar Electric Co, Inc, February 1.

R E Fisher, 71, vice-president of public relations and sales for Pacific Gas & Electric Co, February 12.

James A Ward, 73, president of California-Pacific Utilities Co, February 1.

This message from

Power

appeared recently
in Business Week
to remind management men
throughout iudustry
of the vast scope
and key importance of
power
and of the men
who direct
the power services

→

Reach any Overhead Valve From the Floor with...

Babbitt
—Adjustable—
SPROCKET RIM
with Chain Guide

Get positive, efficient control of any overhead valve right from the floor! No expensive apparatus, no switches, no costly detours to bring overhead piping to floor level — because every valve is within easy reach, when you use low-cost Babbitt Adjustable Sprocket Rim with Chain Guide. Easily assembled and installed, ready to operate in a few minutes.

- Safe, sane & sensible
- Cuts piping costs
- Saves fuel & steam

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems. Only four simple, quickly-assembled parts.

Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.

Babbitt STEAM SPECIALTY CO.

2 BABBITT SQUARE, NEW BEDFORD, MASS.

Who puts out the Biggest Bonus?

How would you like to have a half-million dollar bonus this year—all nicely gift-wrapped in the form of shiny new power equipment?

Could happen right in your own plant. In fact, POWER magazine recently gave the facts on just such a case...

The management men in this Midwest company didn't realize that up-to-date power equipment would quickly pay for itself while boosting profits. Then their own engineers sold them a power-modernization program. It cost $5,017,000. Annual savings are $510,000. The job more than pays for itself in ten years.

How is this possible?

Two of your toughest costs, fuel and labor, have more than *tripled* in recent years. Cutting them back with modern equipment will earn many dollars for you, every minute.

Maybe your opportunity is not this big. On the other hand (if your power equipment is outdated) who knows *how* much money you may be serenely shoveling out through your stacks?

Who knows? One man. The engineer in charge of your power services. The man who makes and delivers your power, and puts it to work on production machinery.

Why not take a good close look, with him, and see how much up-to-date equipment can do. How big a bonus can he pay you next year?

One of America's primary industrial media and a member of the Audit Bureau of Circulations

McGRAW-HILL . . . ABP

A house for tomorrow

When Bill Miller first talked to the architect about his new home he stressed his desire to put into it the soundest materials and the newest conveniences.

"I hope my grandchildren will be happy in this house," he explained. "New improvements come fast these days, so let's try to be a few years ahead in our planning."

"What fuel would you like to use?" asked the architect when the discussion reached the heating plant.

"I would prefer to use coal," answered Bill, "I understand it is the most economical fuel here, as it is in most areas. But I don't want my wife to be a furnace-tender."

"With a modern, bin-feed stoker with thermostatic control," said the architect, "your heating will be completely automatic, as well as clean and convenient. And coal has some big advantages – it gives a steady heat, not an off-again-on-again heat. Then there's this for the fellow who looks ahead: I don't know how long these other fuels are going to last. Every year they have to drill their wells deeper, and we are becoming more and more dependent on foreign supplies. As these other fuels get scarcer, they are going to get even more expensive.

"But coal is another story. There is plenty of coal right here in the United States to last us for hundreds–maybe thousands of years. That's something to think about when you're planning a house with the hope that your grandchildren will still be living in it."

COAL
FUEL OF THE FUTURE

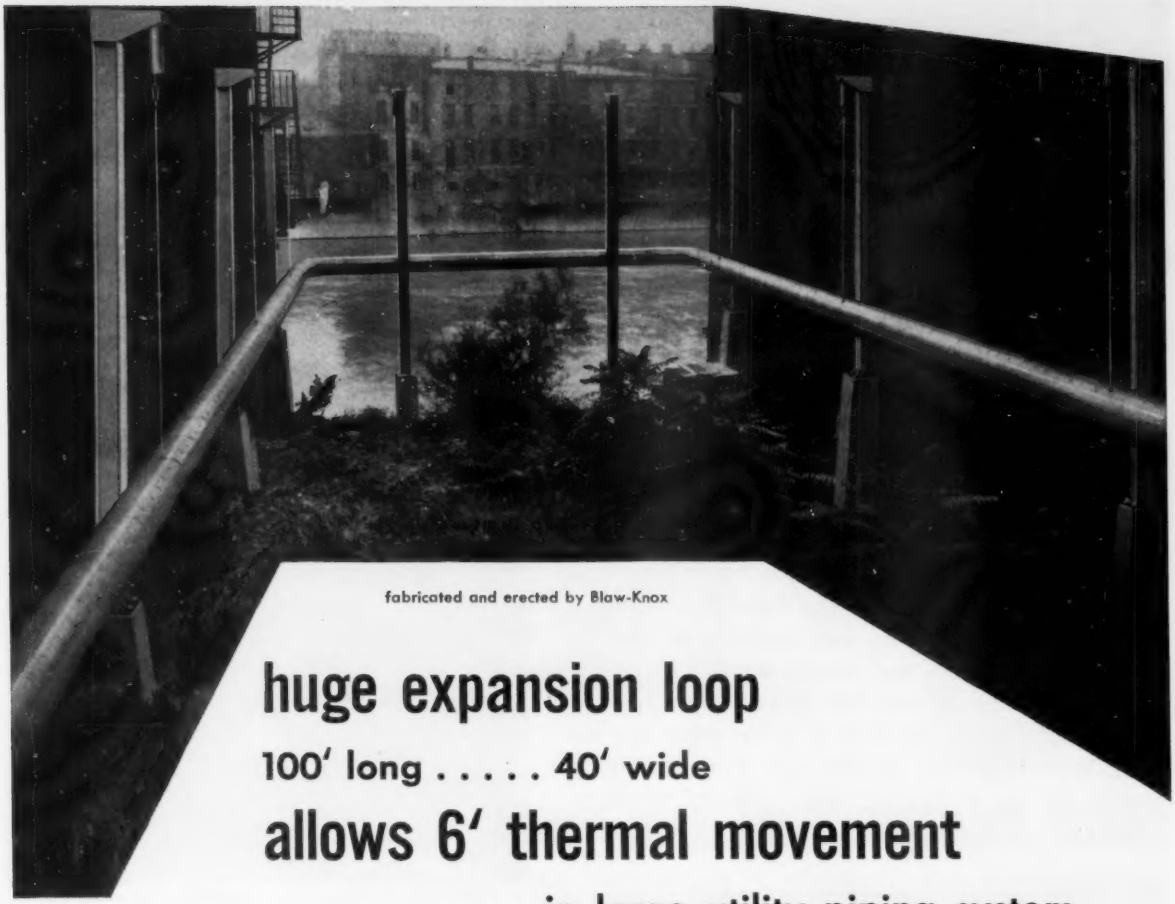
Chesapeake and Ohio Railway

Bring your fuel problems to C&O

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

Write to:

Coal Traffic Department
Chesapeake and Ohio Railway
2115 Terminal Tower
Cleveland 1, Ohio



fabricated and erected by Blaw-Knox

huge expansion loop

100′ long . . . . . 40′ wide

allows 6′ thermal movement

. . . in large utility piping system

This tremendous expansion loop is only one part of a ten-inch power piping line which carries steam at 650# pressure and 750° Fahrenheit for nearly a mile throughout the downtown area of a large city. All bends were fabricated in our shops . . . and installed in the field by our service force, using Blaw-Knox functional hangers and vibration eliminators.

An unusual job . . . and you'll probably never need one just like it. But it points up the kind of service we offer you. For we have the experience and the facilities to handle any type of piping problem.

On a job you place with us, you'll have the benefits of modern shop facilities for hot and cold bending, welding and fabricating all types of piping. A metallurgical research laboratory to assure you of the latest developments in high pressure, high temperature piping. Newest types of testing equipment to insure the soundness and strength of the piping under the most severe operating conditions.

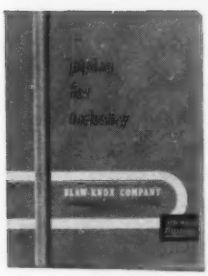
And in addition, a complete service force equipped with modern machinery for field erection . . . and the necessary manpower to handle any size job.

What's your power piping problem?

We are prepared to (1) engineer, fabricate and erect your job . . . (2) simply fabricate and erect . . . or (3) fabricate only.

Our engineers will quote from your drawings . . . or, where desired, make a field study of your piping requirements before quoting.

Write us your requirements . . . and we'll provide the service you need.



To get more information on piping for industry write for your copy of Bulletin No. 2443.

BLAW-KNOX COMPANY

Power Piping and Sprinkler Division

Pittsburgh 33, Pennsylvania

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POWER PIPING

Complete prefabricated power piping systems for all pressures and temperatures . . . plus complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators

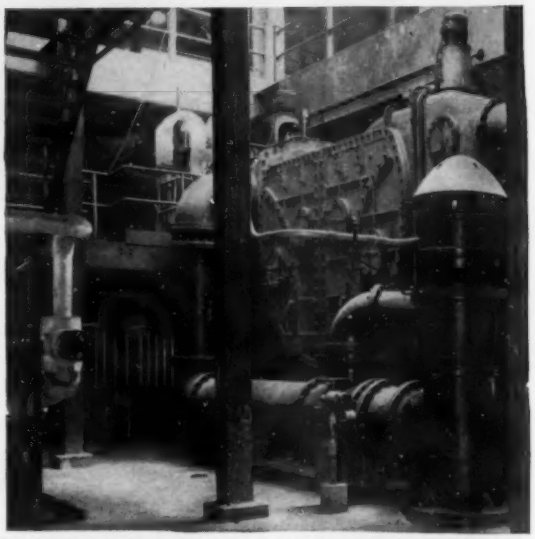
NOTES

for the engineer's note book

. . . ON WHEELER-ECONOMY POWER PLANT EQUIPMENT

NO SHUTDOWN, NO LOAD REDUCTION, NO HAND CLEANING . . . WITH C. H. WHEELER *REVERSE FLOW* CONDENSERS

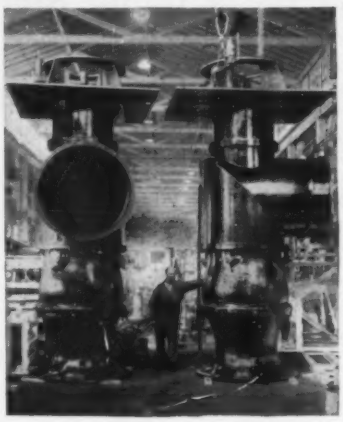
The savings in dollars and downtime effected by C. H. Wheeler's Reverse Flow design for steam condensers are a matter of record in public utilities and private power plants throughout the country. Chances are, you can inspect a nearby installation and learn first hand how efficiently debris of vegetable, animal and mineral matter is dislodged from the tube sheet and flushed away by reversing the flow of the cooling water through the Condenser. Cleaning work that formerly took hours is accomplished in minutes with no interruption in load. C. H. Wheeler custom-engineers your steam condensing hook-up to pay off in long range sustained efficiency. (Bulletins mailed on request.)



WHEELER - ECONOMY CIRCULATORS

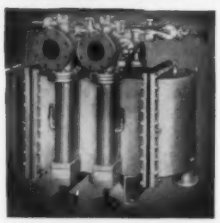
Lasting Dependability
Minimum Maintenance

Wheeler-Economy Circulators include: mix-flow vertical wet pit type with both standard and pull-out design; vertical mix-flow volute type for dry pit installations; and horizontal single stage centrifugal constructions to 100,000 GPM capacities. Wheeler-Economy pumps for general service include: single stage high head double suction; multi-stage with horizontal or vertical split case; pumps for sump, process and fire protection services. Wheeler-Economy also invites your special problems requiring custom design. (Bulletins mailed on request.)



TUBEJET AIR EJECTORS

Steel Shell
More Reliable

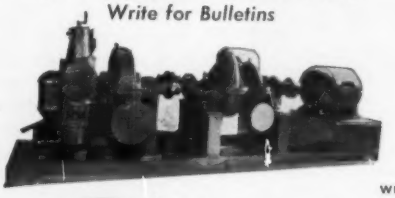


C. H. Wheeler Steel Shell Tubejet Air Ejectors provide worthwhile savings in space and weight. They are available with either single or multiple element, two-stage type with combined surface inter-after condenser. Write for Bulletin.

WHEELER-ECONOMY CONDENSATE PUMPS

for Condenser Service
with Turbine and Motor Drive

Write for Bulletins



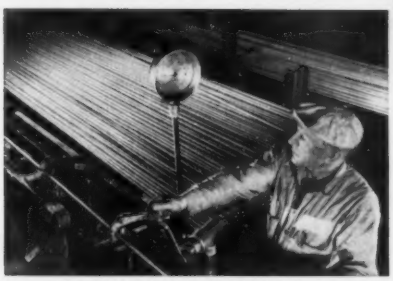
WE-400

C. H. WHEELER *of Philadelphia*

C. H. WHEELER MANUFACTURING CO., 19th & LEHIGH, PHILADELPHIA 32, PENNA.

Steam Condensers • Centrifugal, Axial and Mixed Flow Pumps • Steam Jet Ejectors • Vacuum Refrigeration
High Vacuum Process Equipment • Micro-Particle Reduction Mills • Marine Condensers and Ejectors • Deck Machinery.

Chase Antimonial Admiralty



Every Chase Antimonial Admirally condenser tube is tested to withstand at least 1,000 pounds per square inch water pressure.

Meets every test for Condenser Tubes

Chase flattening test, index of Antimonial Admiralty tube's physical quality and ability to withstand bending or end flaring.

This Chase metallurgist is checking the size and uniformity of grain of Chase Antimonial Admiralty condenser tubes.

When you put Chase Antimonial Admiralty tubes into a condenser you *know* they'll stand up for years. It isn't only that we make certain there's enough antimony to resist dezincification. Chase condenser tubes are carefully tested and retested for *every* physical and chemical property required to meet actual field conditions. It pays to insist on Chase Antimonial Admiralty.

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The Nation's Headquarters for Brass & Copper

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NOT A SINGLE LUMP IN ALL SIX THROATS

Nothing impedes the efficient air flow through the fan throats of Pritchard cooling towers.

The neat design of the modified Venturi throat, the precision-manufactured assemblies and the rigid, bolted construction all contribute to smoother air flow and permit the closest possible blade clearances. Such exactness results in exceptional fan efficiency.

You want outstanding cooling performance. You want to increase the efficiency of your power plant. Then find out all the reasons why Pritchard Heavy-Duty Cooling Towers do these jobs better. Contact your Pritchard representative listed in the classified section of the telephone directory or write direct to the address at right.

Industry's Partner for Progress

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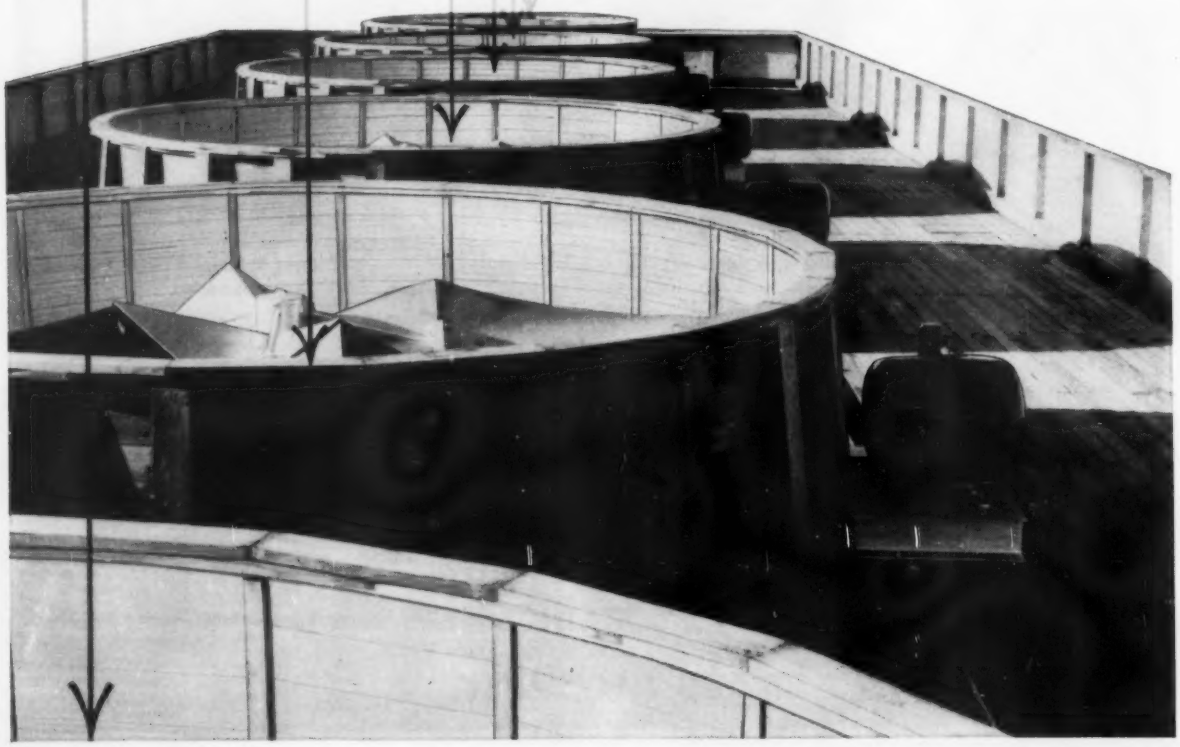
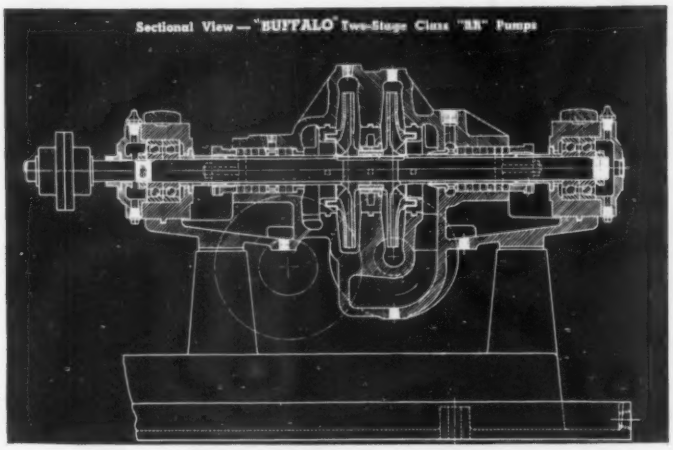
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 364 210 West 10th St., Kansas City 5, Mo.

COOLING TOWERS
SPECIALIZED HEAT EXCHANGERS
GAS & AIR TREATING EQUIPMENT

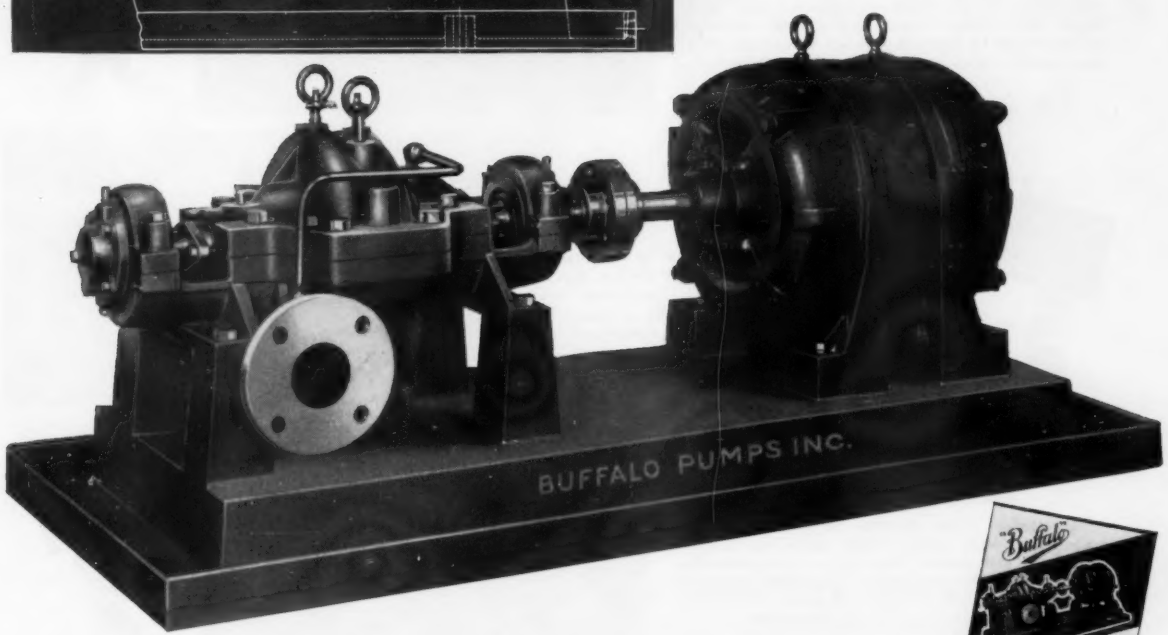
Representatives in Principal Cities from Coast to Coast



BLUEPRINT FOR SATISFACTION



in HIGH-PRESSURE *Clear Water* PUMPING



A look at a sectional drawing of a "Buffalo" 2- or 4-stage Type "RR" Pump will readily show you why this pump is giving complete satisfaction. Full ball bearing support on each end of the oversize shaft gives the pump strength where it counts. The husky, enclosed impellers mean lastingly high efficiency. The deep stuffing boxes (large enough for 7 rings of packing in the 2-stage model illustrated) keep maintenance to a minimum. Passageways in the casing are formed to give a "path of least resistance", and the casing is horizontally split for easy rotor inspection.

And every "Buffalo" Pump *has* to prove itself before it ever leaves the factory . . . in a thorough load test. You *know* it will do your job . . . and keep on doing it . . . to satisfaction.

Write for Bulletin 980-C today!

Write for Bulletin 980-C Today

"Buffalo" PUMPS

BUFFALO PUMPS, INC.

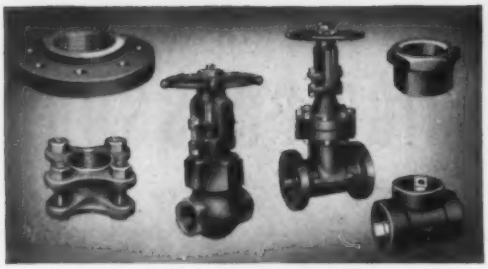
488 BROADWAY BUFFALO, N. Y.

Subsidiary of Buffalo Forge Company

Canada Pumps, Ltd., Kitchener, Ont. Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

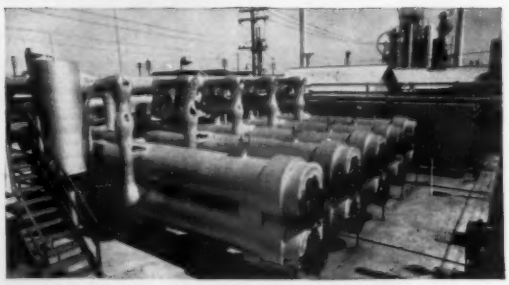
Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

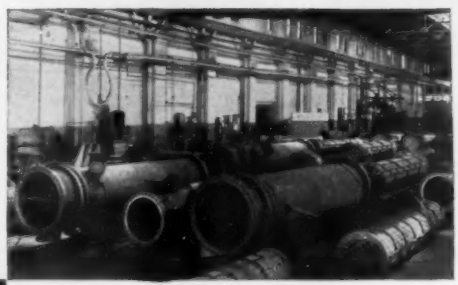
PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.



MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.

Vogt

PRODUCTS

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ANNOUNCING

THE APPOINTMENT OF

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AS GENERAL AGENTS FOR

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Manufacturers of

Seamless Steel Products

DALMINE, S. P. A.
MILANO, ITALY

Offering a complete range of seamless steel pipe up to 34 inches O.D. in carbon and alloy grades, including seamless steel light and transmission poles. Made in accordance with A.S.T.M. specifications. Can perform all supplemental tests under A.S.T.M. specifications.

Dalmine Seamless Products are made to measure for the Power Industry.

Address inquiries for stock and specific requirements to

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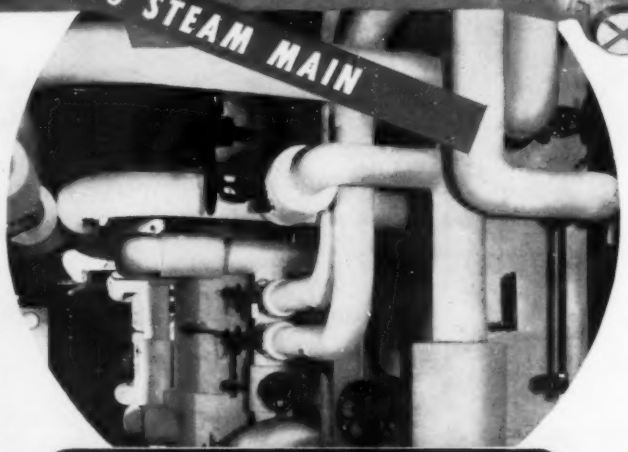
PLaza 7-4700

WHEN THE PRESSURE IS ON P.P.&E. PIPING

has what it takes

FROM CONTROL PIPING TO STEAM MAIN



Today's 1000°F and higher temperatures, combined with pressures in the 2000 psi range——really "put the pressure" on a piping system. It could be said that these higher, and perhaps even higher pressures to come, will force new standards of piping.

But—remember when 750°F was considered to be a high reheat temperature? Even then, P.P.& E. was ahead of the needs in piping to carry the load. As the trend toward higher temperatures continued—P.P.& E. has kept ahead of the requirements.

That's why conditions encountered in present-day reheat temperatures are thoroughly understood by P.P.& E. engineers—and why adequate materials, design know-how, methods of treating and fabricating, and testing procedures are available.

When the "pressure is on" you can depend on every part of a P.P.& E. piping system—from the steam main, right down to the air lines.

Pittsburgh Piping

AND EQUIPMENT COMPANY

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Boston . . . . . 10 High Street	Houston . . . Heights State Bank Bldg.
Charlotte . . . . . 221 Builders Building	Los Angeles . 1830 N. Alexandria Ave.
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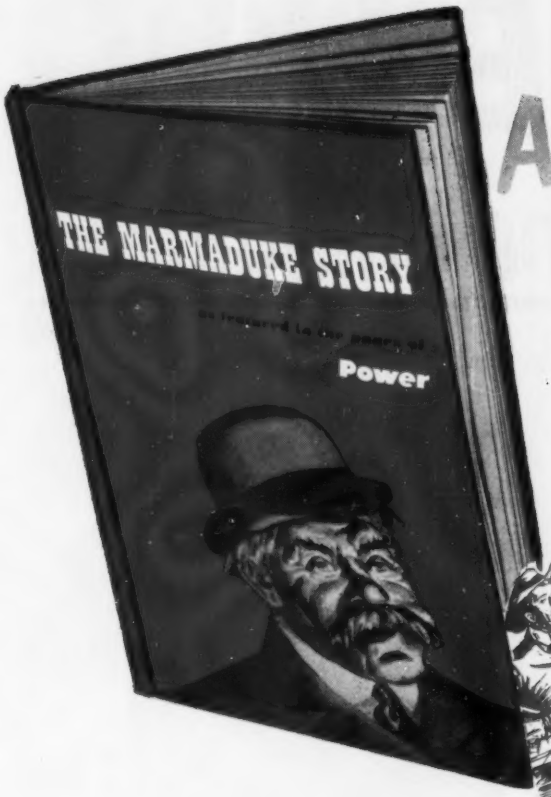

A SHIP LOAD of wonderful Marmaduke stories

. . . and only $1.

Here are *twenty-one* of Marmy's most fabulous exploits, exactly as told in the pages of POWER.

Here is the cantankerous old sea dog turned into a consulting engineer, whose ingenuity is amazing but always possible and even plausible.

As POWER readers well know, Marmy's office is upstairs over O'Houlihan's Machine Shop & Engine Works, where the phone number is Hell's Kitchen 2-1876. But his principal hangout is in The Bent Propeller Bar, whose proprietor's name is Bedlam, and where you're likely to find Marmaduke meditating over a bottle of Sandpaper Gin.

We have good reason to think that Marmaduke Surfaceblow is about the best known character in the power field—maybe in all industrial journalism. Here are the stories that made him so, handsomely bound in a colorful varnished cover, only one dollar. Supply is limited. Order today.

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MATCHLESS EFFICIENCY

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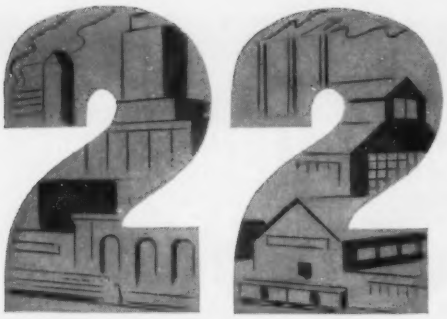

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In every state and in many foreign countries as well, those who specify and those who use **like** our equipment. Clarage specializes — we build air handling and conditioning equipment exclusively.

You can have faith that a Clarage unit is figured RIGHT for the required performance . . . built RIGHT to operate year after year with minimum attention.

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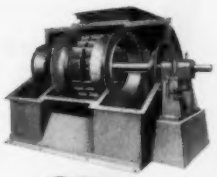
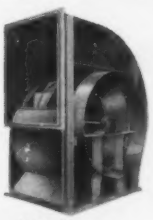
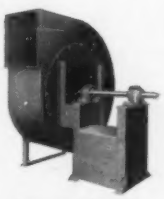


Equipment for forced and induced draft service

Ready-to-run units for light-duty ventilating

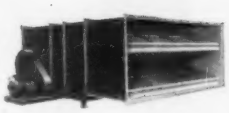


Fans for ventilation and air conditioning

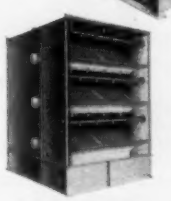


Fans and blowers for industrial services

Cast iron fans for special industrial applications



Multitherms — complete "package" air conditioning units



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SEAMLESS — MECHANICAL — PRESSURE — CORROSION RESISTANT

TYPICAL ANALYSES:

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Carbon ½ Moly	7 Chrome ½ Moly
½ Chrome ½ Moly	8 Chrome ½ Moly
1 Chrome ½ Moly	8 Chrome 1 Moly
1¼ Chrome ½ Moly	9 Chrome 1 Moly
2 Chrome ½ Moly	3% Nickel 7% Nickel
2¼ Chrome 1 Moly	5% Nickel 9% Nickel

AISI Types: 304-321-347-316-309-310-405-410-430-443-446

Analyses to meet conditions where heat, corrosion, pressure and structural strength are involved.

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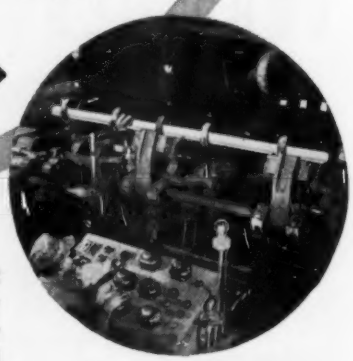

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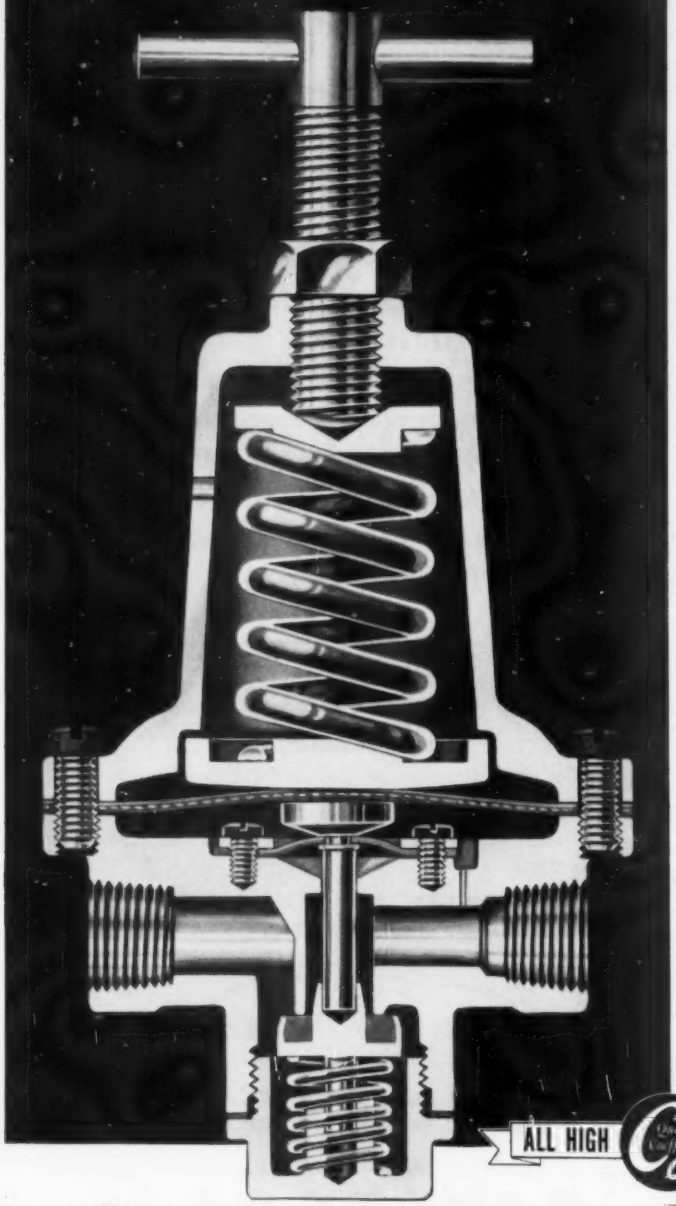
MASONEILAN No. 71
FOR AIR



Tough Guy!

Here's a tough air regulator that reduces maintenance to a minimum. Compact, easy to service, its simple design and sturdy brass construction stands up under rugged use and abuse.

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Masoneilan No. 71 responds instantly to pressure variations . . . stabilizes line pressures . . . keeps them accurate. It provides uniform control, large capacity with minimum pressure drop.

Available for pressures up to 250 psi reduced to any pressure from 5–60 psi; 60–100 psi. Sizes ¼" to ½". Pressure gauge included. For more information, write Mason-Neilan Regulator Company, 1186 Adams Street, Boston 24, Mass.

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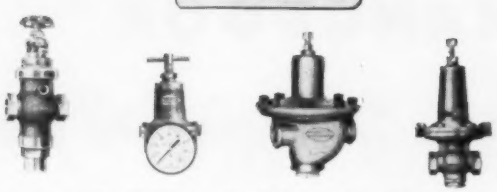


No. 11 for steam No. 71 for air No. 227 for water No. 33 for steam, air

MASONEILAN REGULATORS

Keep Pressure Under Control!

THIS YEAR

POWER's Modern Plant Handbook (coming September 15) **will be bigger, more useful, closer than ever to the problems and progress of the power field.**

—for POWER readers *are taking an active part in writing the 1954 edition. "The Power Awards for Modernization" will present actual case histories of modernization programs, supplied by readers of POWER, showing problems, costs and results.—plus the other great features that make The Modern Plant Handbook an outstandingly useful issue:*

THE MODERN PLANT SURVEY
Technical details on over 500 new plants

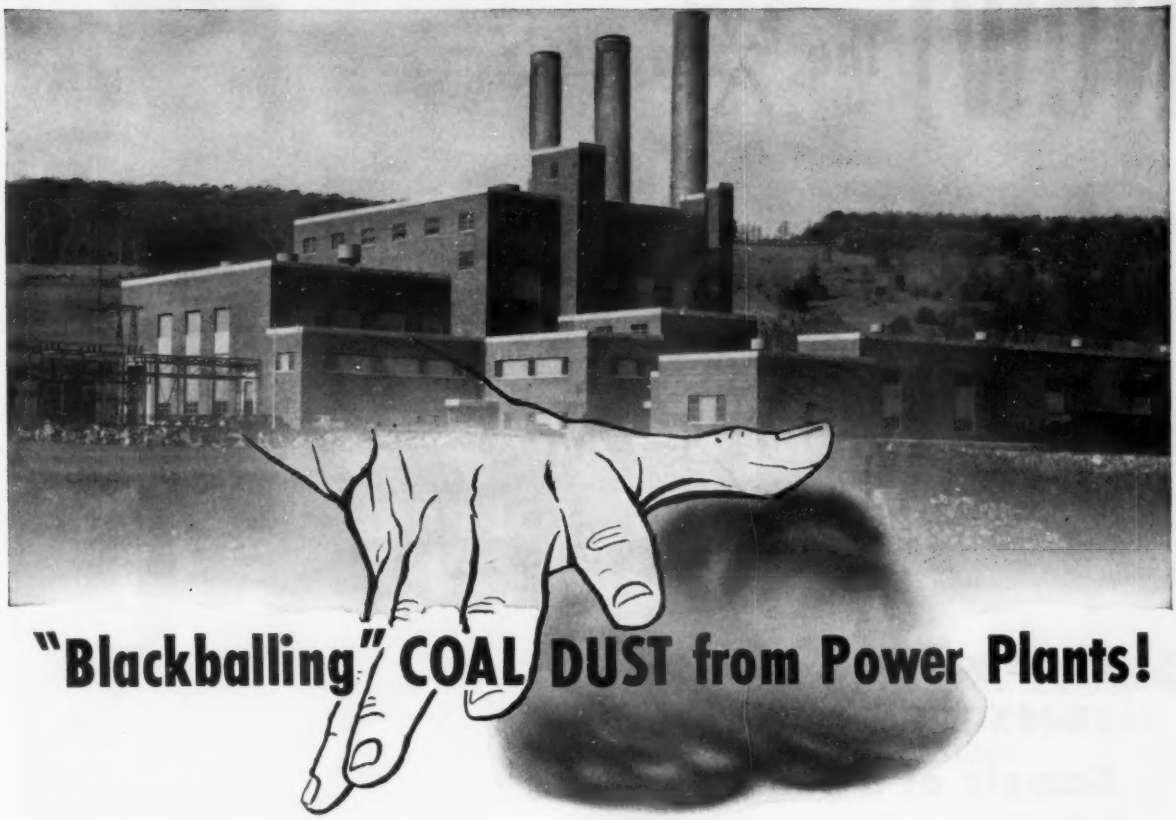
DIRECTORY FOR MODERNIZATION
The only directory of power-field equipment

CROSS FILE OF OBSOLESCENCE
Former manufacturers matched with successor companies

THE SHOW CASE
New products and their manufacturers

WATCH FOR THE HANDBOOK

You'll want to use it throughout the year



"Blackballing" COAL DUST from Power Plants!

THE CONTROL OF COAL DUST in power plants has been perfected by Johnson-March with engineered systems that stop coal dust at its source . . . wherever it occurs . . . before it can become airborne.

NO LONGER NEED COAL DUST BE . . .

- a maintenance problem
- a community nuisance
- a fire or explosion hazard

LOW-COST INSTALLATIONS at car dumpers, crushers, hoppers, belt galleries and coal piles are successfully eliminating coal dust in many leading power plants throughout the country. Similarly, fly ash handling and disposal need no longer be a dust problem. No costly ducts, hoods or fans to interfere with normal operations. First cost is 1/10 that of other systems and maintenance cost is next to nothing.

JOHNSON-MARCH ENGINEERED SYSTEMS are used in many plants to supplement and improve the effectiveness of existing mechanical dust collection systems. If you now have such a system, or if you have no control over coal dust, let Johnson-March engineers analyze your dust problems and recommend an economical "custom-made" system that will eliminate your plant and community dust nuisance. Write for full details.

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Dust Control Engineering

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NOW! the *American*

SAMPLE CRUSHER

with the New Adjustable SAMPLING HOPPER

Model 9x9 American Sample Crusher with adjustable sampling hopper.

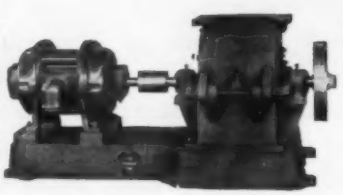
gives you a 5%-10%-15% or 20% Sample of a Sample

...*in One Operation!*

THE NEW American Adjustable Sampling Hopper gives you a truly representative sample . . . as much or as little as you need, in any amount from 0 to 20% *by simply setting a dial* . . . and does it in *one* operation – so quickly and efficiently that there is no loss of moisture content in the sample.

When teamed up with one of the famous American Sample Crushers (as the Model 9x9 illustrated above), your crushing operations are FAST, because you can crush as much as a ½ ton per hour . . . EFFICIENT, because you have a once-through operation . . . and LOW COST, because there's practically no wear-out to an American Sample Crusher.

Model 15x9 American Sample Crusher, for capacities up to 2,000 lbs. per hour. For larger capacities, we recommend the American "13" Series (capacities up to 6 tons per hour).



WRITE for complete literature on American Coal Sample Crushers

American PULVERIZER COMPANY

Coal Crushers up to 800 TPH
Sample Crushers up to 6 TPH

Originators and Manufacturers of Ring Crushers and Pulverizers

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TAKES THE THROB OUT OF POWER

PENFLEX TUBING

"SOAKS UP" VIBRATION . . . PROVIDES SMOOTHER COOLING OPERATION

WHEN A 16-cylinder, 1,750-hp diesel engine roars into action, the air-cooling and circulation piping really has to "take it." This particular installation performs perfectly because it is equipped with Penflex Flexible Metallic Tubing. A 5-foot length of air-jacketed 14" interlocked Penflex Tubing reaches from exhaust to stack. Its tough, rugged, "seep-proof" construction holds exhausts tight as a pipe . . . yet it is flexible enough to absorb the constant vibration.

In the power field you have many calls for Penflex—for air and gas lines, for transmission of oil, steam, and liquids. There is a complete line of steel, bronze, and aluminum Penflex Flexible Tubing, Hose and Couplings in sizes from 1/8" to 24" I.D.

Write today for new illustrated data book on "Flexineering"—the science of engineering flexible tubing to your specific job.

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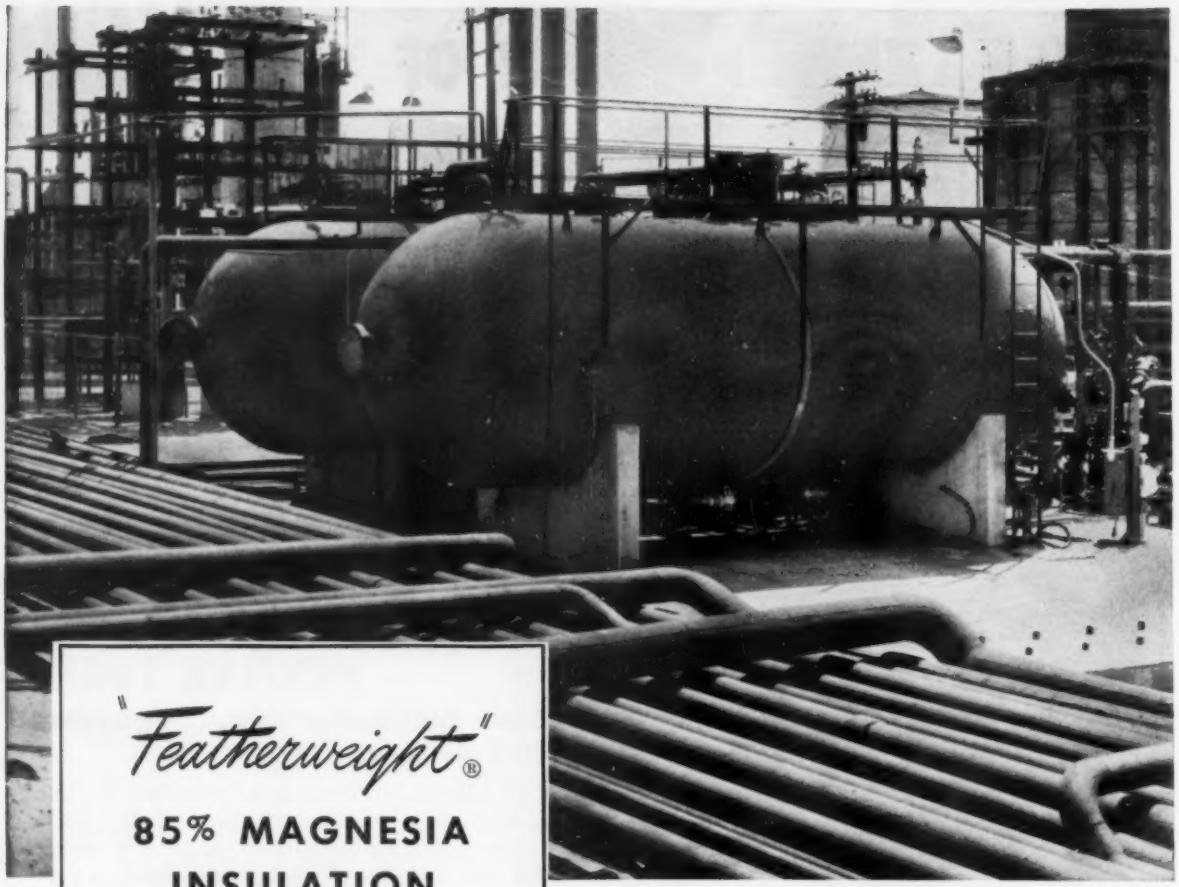
PENFLEX

HEART OF INDUSTRY'S LIFE LINES



"Featherweight"®

85% MAGNESIA INSULATION

Desalters and piping in West Texas Refinery, insulated with "Featherweight" 85% Magnesia and covered with weatherproofing materials. Insulation contractor: Willard A. Selle Co., Inc., El Paso, Tex.

helps refinery conserve dollars

"Save heat—save money" is an operating rule that holds true for almost every industry. In the refinery illustrated here, heat is effectively conserved by the use of "Featherweight" 85% Magnesia, used to insulate various pieces of hot piping and equipment.

For any industrial insulation use, "Featherweight" proves to be a thrifty choice. By itself this material (85% basic carbonate of magnesia and asbestos fiber) has an effective insulating range up to 600°F. Used with K&M Hy-Temp Insulation, its range is extended to 1900°F.

Hy-Temp is applied directly to the hot surface, and "Featherweight" is used as the second layer. The two materials, when applied with staggered vertical and horizontal joints, eliminate heat loss which occurs on single layer installations when the expansion of hot piping and equipment causes joints to open.

These K&M insulations will last the life of the equipment they serve, will withstand moisture, vibration, and frequent temperature change. With a waterproof jacket, they serve equally well outdoors. Both materials are supplied in various sizes and thicknesses.

Your K&M distributor is an experienced applicator who will gladly give you more information about these heat-saving, money-saving K&M insulations. Or write directly to us.

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Nature made asbestos... Keasbey & Mattison has made it serve mankind since 1873

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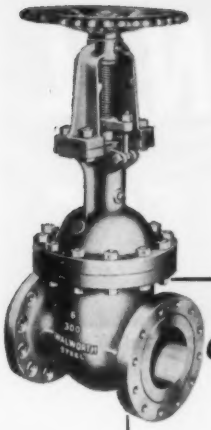
K&M best in asbestos ®

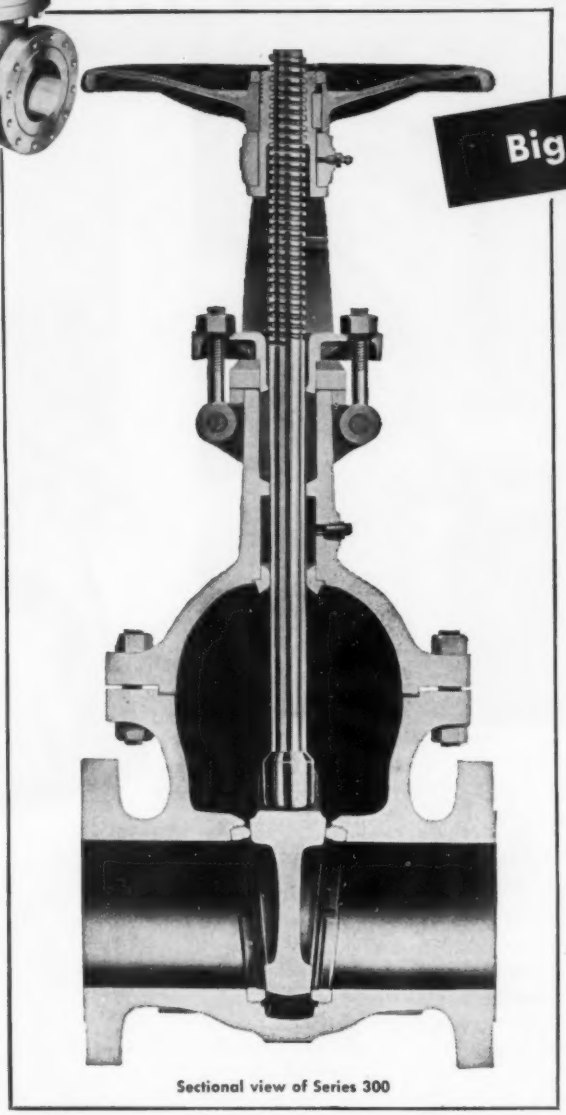
WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke





Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2" to 24") insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Roller bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

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valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

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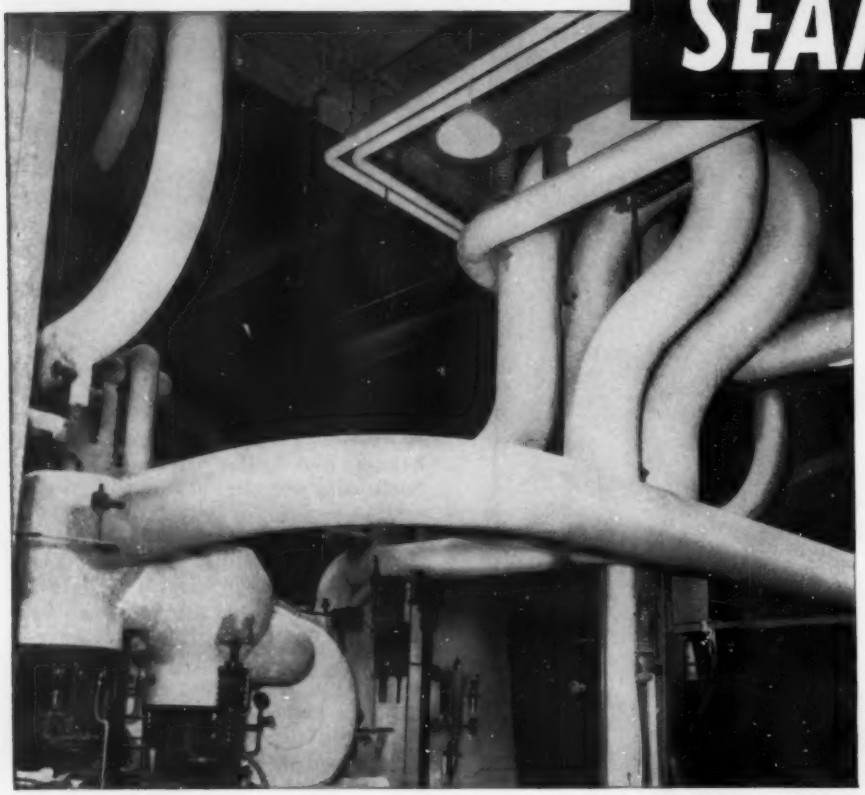
Play it Safe with NATIONAL SEAMLESS



● With pressures and temperatures constantly increasing, plant engineers everywhere are putting their complete confidence in U·S·S NATIONAL Seamless Pipe and Tubes. And for good reason. The life of a modern steam plant hinges on the dependability of its high pressure steam lines. And there is no more dependable power piping than NATIONAL Seamless —the famous "Walls Without Welds" that give you the extra margin of safety that only Seamless provides.

U·S·S NATIONAL Seamless has never been surpassed for power plant service, even under the severest operating conditions. Pierced from solid billets of steel, NATIONAL Seamless Pipe and Tubes have the strength, uniformity, and dependability of solid forgings. Each length is an homogeneous steel cylinder with uniform wall strength throughout. NATIONAL Seamless is designed to remain structurally sound under high temperatures and intense pressures.

If you're planning the building of a new plant or repiping a present installation, remember to "play it safe" and specify NATIONAL Seamless Pipe and Tubes for longer, safer, more dependable, more economical service.

Further information about NATIONAL Seamless Pipe and Tubes for power plants is offered in the following free booklets:

Bulletin Number 26 — concerns the properties of steels employed for elevated temperatures.

Bulletin Number 10 — technical data on high-pressure power plant piping.

Write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

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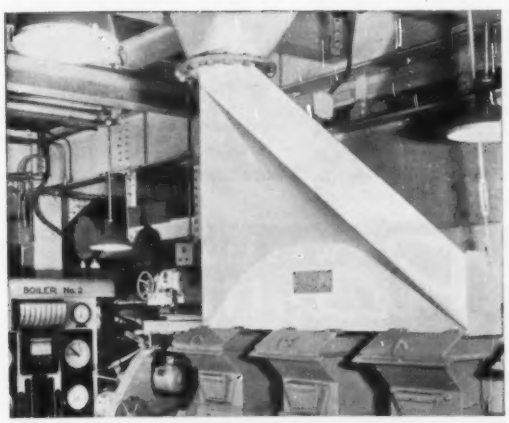
U·S·S NATIONAL Seamless PIPE AND TUBES

USS

UNITED STATES STEEL

If Your Problem is Smoke—

and your boiler is stoker fired, it is very probable that an important contributing factor to the problem is segregation of the coal as it is delivered to the stoker. The proper application of a S-E-Co. CONICAL Non-Segregating Coal Distributor will overcome this condition of segregated coal and, thus, will materially help eliminate the smoke nuisance. The S-E-Co. CONICAL Distributor will not only help you obtain better combustion, resulting in less smoke and higher overall stoker efficiency, but you will find that both stoker and furnace maintenance requirements will also decrease.



S-E-Co. CONICAL Non-Segregating Coal Distributor complete with dust-tight slip joint connections to individual spreader stoker hoppers.

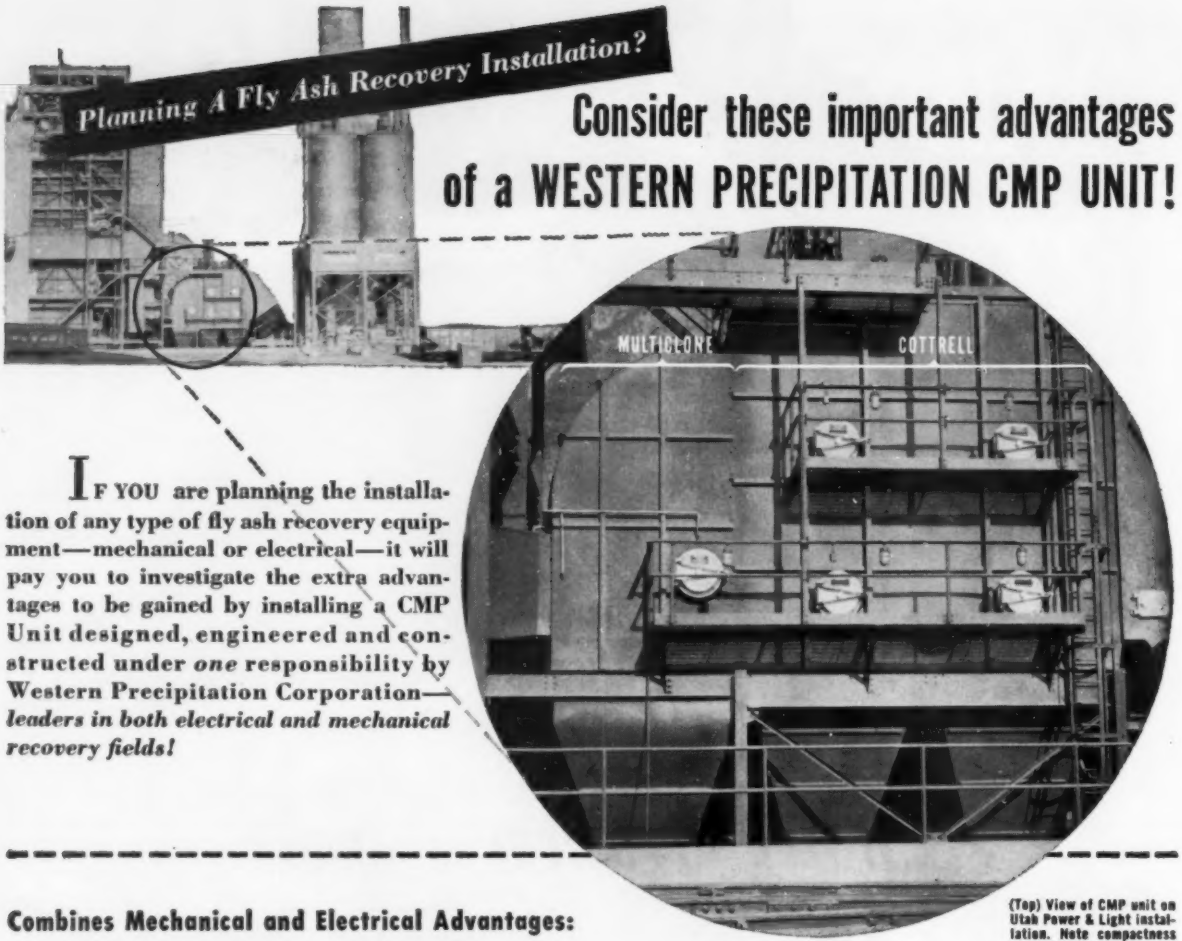
In addition to the CONICAL Distributor, Stock Equipment Company also manufactures the S-E-Co. Coal Valve, Automatic Coal Scale, Automatic Under-Bunker Conveyor, No-Flow Coal Alarm and many other related items necessary to a modern Bunker to Stoker (or Pulverizer) Installation. If you want help in preventing smoke, in modernizing your plant, or in adding a new unit, why not contact a local S-E-Co. representative and take advantage of the unique help Stock Equipment Company can offer because of experience gained through years of specializing in this particular field.

STOCK EQUIPMENT COMPANY
745-P HANNA BUILDING
CLEVELAND 15, OHIO

Specialists in Bunker to Pulverizer and Bunker to Stoker Equipment

Planning A Fly Ash Recovery Installation?

Consider these important advantages of a WESTERN PRECIPITATION CMP UNIT!



(Top) View of CMP unit on Utah Power & Light installation. Note compactness of unit. (Above) Close-up of same installation.

IF YOU are planning the installation of any type of fly ash recovery equipment—mechanical or electrical—it will pay you to investigate the extra advantages to be gained by installing a CMP Unit designed, engineered and constructed under *one* responsibility by Western Precipitation Corporation—*leaders in both electrical and mechanical recovery fields!*

Combines Mechanical and Electrical Advantages:

A CMP (Combination Multiclone-Cottrell Precipitator) Unit combines—in one compact installation—both mechanical and electrical recovery principles, so that maximum benefit is obtained from the advantages inherent in each method. The MULTICLONE section centrifugally cleans the gases of the larger and heavier fly ash particles (down to a few microns in diameter) . . . and the COTTRELL Precipitator then electrically removes the very small particles remaining in the gases. This combination arrangement has important advantages:

1. Using the MULTICLONE for cleaning out the heavier particles permits the bulk of the recovery operation to be performed with relatively low-cost equipment.

2. Using the COTTRELL for final clean-up insures unusually high recovery efficiency—approaching theoretically perfect, if desired—with a high efficiency, compact Precipitator unit.

3. Each type of unit—MULTICLONE and COTTRELL—can be arranged for its most efficient application. MULTICLONES may be connected to each separate boiler, if desired, and their draft requirement cut out when the boiler is down . . . while a central COTTRELL handles all gases and operates at higher efficiencies, with continued low power cost, when one or more boilers are down.

4. During soot-blowing periods, or while warming up cold boilers, the MULTICLONE efficiency usually increases, preventing overloads of detrimental carbon from reaching the COTTRELL.

Only Western Precipitation Combines Multiclone and Cottrell "Know-How"—In ONE Organization!

A vital factor in obtaining maximum efficiency and economy in CMP installations is the proper balance of mechanical and electrical recovery equipment to the individual requirements of *each* application. Western Precipitation is unique in that it not only pioneered the commercial application of COTTRELL Electrical Precipitators over 43 years ago, but also has been a leader for many years in the *mechanical* recovery field with its widely-recognized MULTICLONE Collectors.

Result—Western Precipitation has the all-important "know-how" and experience in BOTH fields . . . knows from first-hand experience how to fit the *right* equipment in the *right* place, to do *your particular* job . . . and can provide the complete installation under ONE responsibility and ONE overall guarantee!

Let Our Experienced Engineers study your recovery requirements and make recommendations on the equipment best suited to your operations. A wire, phone call or letter to our nearest office places this unique "Know-How" at your service, without obligation!

Send for descriptive literature!

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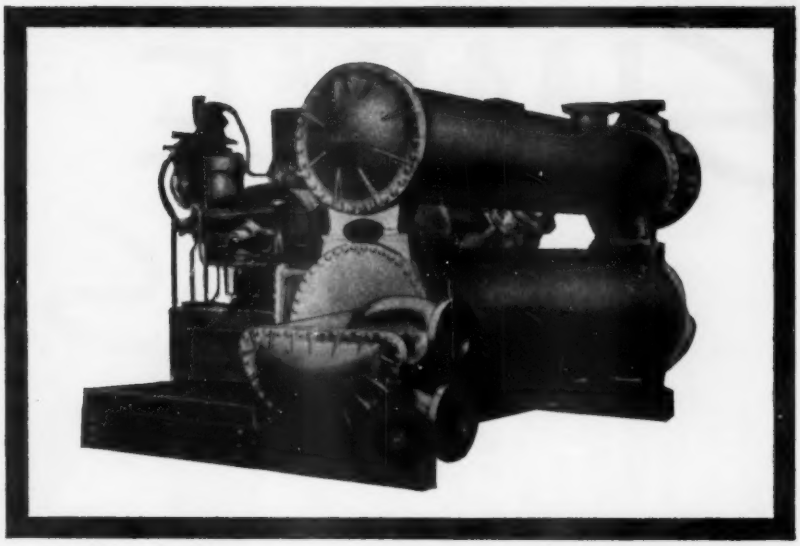
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

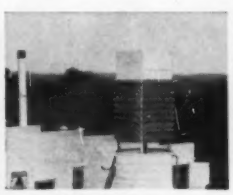
Having Cooling-Water Troubles?



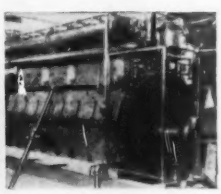
Let MOGUL help you

Water-cooling problems are caused by deposits of rust and scale clogging water passages and forming insulating coatings on heat exchanging surfaces. Mogul effectively and safely removes such deposits, forms a protective film on the cleaned metal surfaces and prevents new deposits from forming. Mogul reduces time and money wasting shut downs and maintains high cooling efficiency in water cooling systems.

Compressors



Cooling Towers



Diesel Engine Cooling

The North American MOGUL Products Company
Cleveland 13, Ohio

If you have never used Mogul naturally you don't know how effective it is. We would like you to see for yourself how well it cleans water passages and keeps them clean. Just mail the coupon and we will send you, no charge, a can of Mogul Rust Eradicator for your personal car. The same formula has been used successfully for years in trucks and busses.

See for yourself how effectively it conditions water systems—keeps them operating efficiently.

Treat Your Car's Cooling System FREE!

COUPON

The North American Mogul Products Company
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Send me one trial-size can of Mogul Rust Eradicator for my car, no charge.

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SIMPLE AS

Getting profitable life from castings which must face heavy abrasive service is simple as A B K.

ABK Metal castings stand up better and last longer because of carefully controlled metallic structure and specified hardness (500 to 700 Brinell). Because ABK Metal has those extra qualities that ordinary "abrasion resistant" metals lack, you can expect up to seven times greater service from ABK Metal castings.

The extra life of ABK Metal castings saves you dollars both in replacement parts and labor—cuts downtime, increases your operating efficiency. Let us show you how ABK Metal, an exclusive Brake Shoe product, can solve your abrasive wear problems.

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AMERICAN Brake Shoe COMPANY

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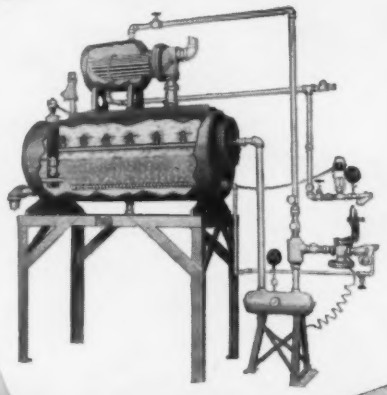
BRAKE SHOE AND CASTINGS DIVISION

230 Park Avenue, New York 17, N. Y.

a Fresh approach . . . a Major advance . . .

in boiler feedwater deaeration



SCHAUB ZERO-OXYGEN Deaerators

NEW DESIGN! NEW PERFORMANCE! NEW SAVINGS!

Complete Oxygen Removal (to .005 cc/liter) • Complete Safety and Dependability • Wide Range for Load Variations • High Thermal Economy • Low Maintenance Costs • Simpler Design for Trouble-Free Service

Start with an idea that's *basically* new and better. Then produce performance beyond the best that ordinary deaerators can deliver. Schaub engineers achieved it . . . developed the all-new deaerator that's a major advance in boiler feedwater deaeration!

Two basic differences give the Schaub Zero-Oxygen Deaerator its outstanding advantages . . . note them well. First, it provides *external* pre-heating to a temperature *above* boiling point, with over-atmospheric pressure held only up to the internal sprayer manifold! Second, a free, non-restricted vent liberates *all* air *immediately* with maximum vapor heat recovery!

From these simple fundamentals stems a whole series of all-important performance benefits. Every engineer or operating man concerned with boiler feedwater deaeration should have the full facts on all-new Schaub Zero-Oxygen Deaerators. Simply send the coupon to get the complete story — promptly.

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2105 South Marshall Boulevard • Chicago 23, Illinois

FREE FACTS!
SEND COUPON TODAY
FOR BULLETIN 575

Tells why you need deaeration. Explains basic differences in deaeration systems. Here's the complete story on new Schaub Zero-Oxygen Deaerators.

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Please send me without cost or obligation, my personal copy of your new bulletin 575 on Boiler Feedwater Deaeration.

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R/M's BIG 7 Packing Types meet 95% of all packing needs

Circulating pumps like this one, which is used to circulate water to a cooling tower, give top performance with R/M Packing No. 1840, a universal packing included in Type 1 of R/M's Big 7 Packing Types.

Let R/M lower your maintenance costs

R/M's Big 7 Packing Types are engineered to give custom-built performance in all but the very rarest packing applications. By standardizing on this basic line of just seven field-tested packing types (you probably need only three or four in your plant) you can reduce the number of times you have to re-pack, the labor costs of packing, the labor costs of "too frequent" adjustments, the costs of damage to equipment, and the costs caused by non-uniform performance. You will also be able to cut your packing inventory and simplify your ordering. For details, call in your R/M distributor.

R/M PACKINGS FOR MAINTENANCE PURPOSES ARE SOLD ONLY THROUGH AUTHORIZED R/M DISTRIBUTORS

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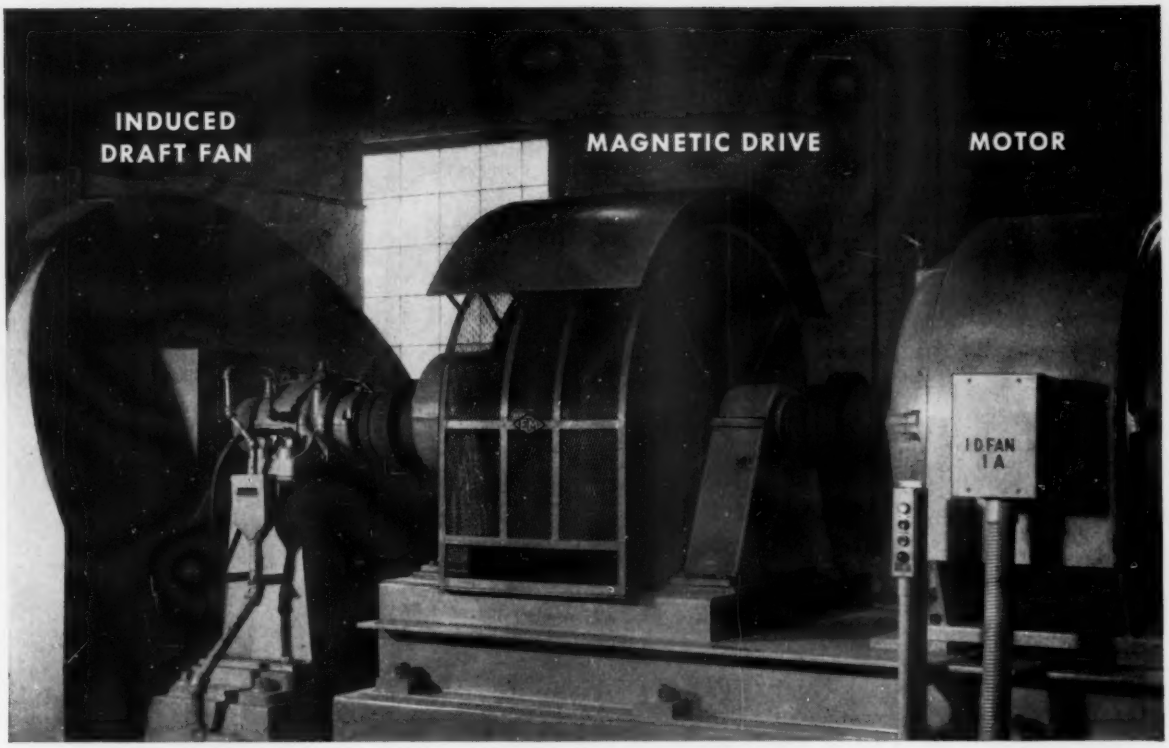
BIG 7 PACKINGS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada.

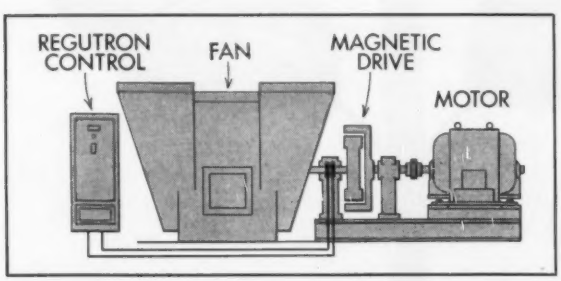
RAYBESTOS-MANHATTAN, INC., Packings • Asbestos Textiles • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Bowling Balls



Now 18 E-M Magnetic Drives for Potomac Electric Power Company

● The clean, compact E-M Magnetic Drive above gives adjustable speed for an induced draft fan at the Potomac Electric Power Company Buzzard Point plant, Washington, D.C. This Drive is rated at 550 hp, 850/90 rpm. The first Magnetic Drives were installed by this large, rapidly growing utility in 1941.

These E-M Magnetic Drives transmit torque electromagnetically from constant-speed a-c drive motors to vary the speed of the fans. The Magnetic Drive responds precisely to the speed dictated by the automatic combustion control.



E-M MAGNETIC DRIVE SYSTEM for induced draft fan speed control consists of a constant-speed motor, the Magnetic Drive, and the E-M "Regutron" Speed Control. Operating speed of the "magnet" coupled to the fan shaft is held at the desired value by the "Regutron" which supplies d-c excitation to the "magnet" in accordance with the demands of the combustion control system.

Among the advantages of Magnetic Drive speed control you will find:

1. **Savings in Driving Power.** Because fan operating speed is no more than required, drive power is used most sparingly.
2. **Reduced Blade Erosion.** When boiler load is reduced and fan speed is reduced accordingly, "sand blasting" effect on the blades by airborne particles is reduced to a minimum.
3. **Precise Control of Air Flow.** The E-M Magnetic Drive maintains fan speed to within plus or minus *one-half percent!*
4. **Easy and Economical Maintenance.** The Drive and its control contain few moving parts. It is simple to understand and requires little maintenance. No auxiliary cooling equipment needed.

Ask your nearest E-M sales engineer for more facts and figures on this simple, economical method of driving draft fans. And write the factory for E-M Publication No. 1107 containing pictures and data on typical Magnetic Drive applications.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

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E-M

Magnetic Drives **MAKE DRAFT FANS DO EXACTLY WHAT YOU WANT THEM TO**

50 YEARS OF PROGRESS ... and STILL GROWING

For half a century we have been serving outstanding industries and institutions—thousands of engineers from coast to coast, in many foreign countries and at sea the world over choose PEROLIN. Adaptability to their maintenance problems and dependability have made our organization a leader in this field.

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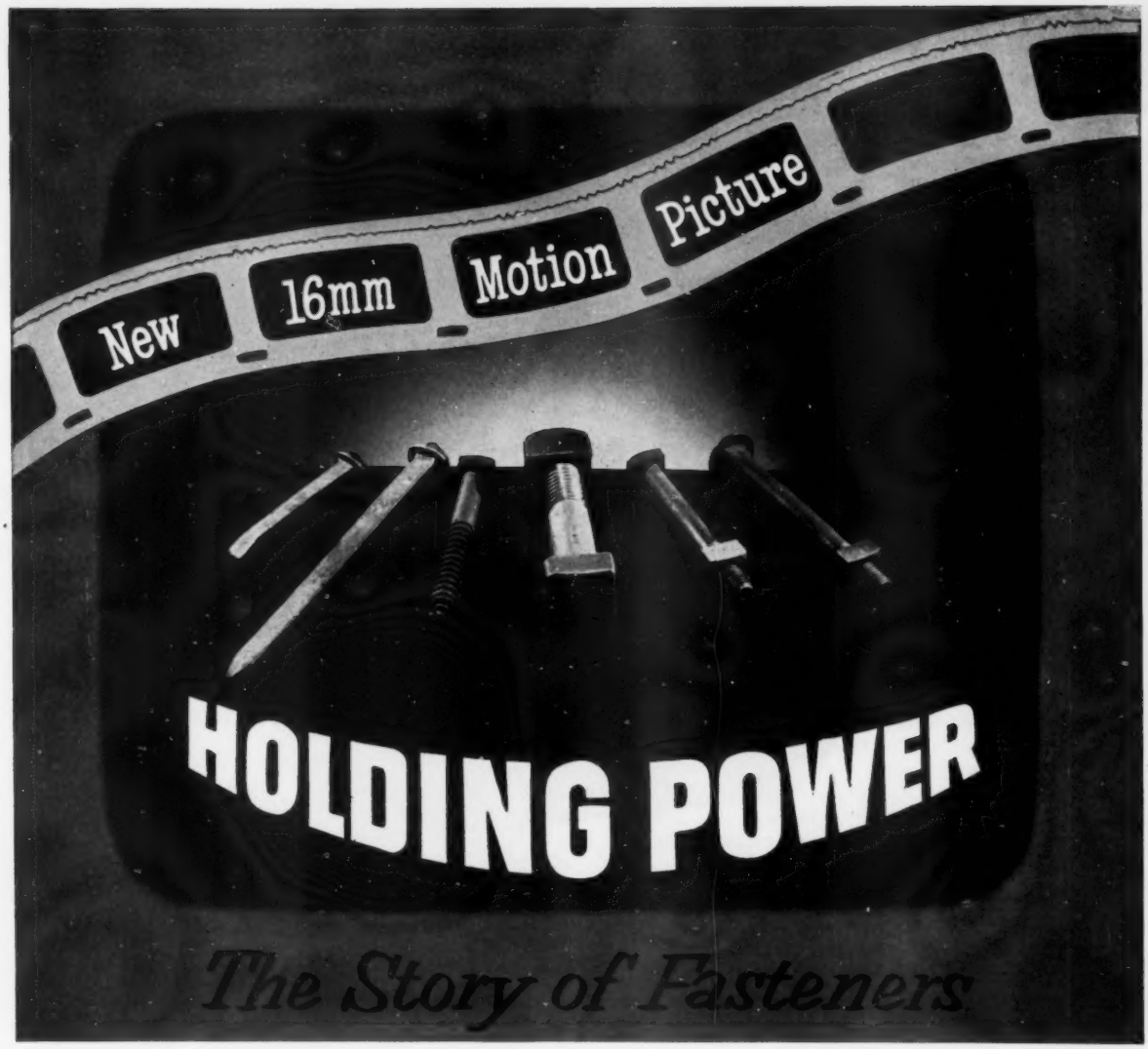

This important new film dramatizes the story of fasteners. It delves into such common, everyday items as machine bolts, nuts, rivets, track bolts and spikes, and also describes roof bolts, high-strength bolts, oil-well sucker rods, and a wide range of special fasteners. The film takes you behind the scenes in our modern fastener plants. It shows how fasteners are made, and explains the vital part they are playing in industry.

"Holding Power" is in color, with sound. It is on 16mm film, and has a running time of approximately 25 minutes.

"Holding Power" is an ideal film for showing to distributors, consumers, and others closely associated with fasteners. It is also an interesting, highly educational picture for general audiences. There is no charge, except for the return postage. If you would like a print for showing, fill out the coupon, selecting a date well in advance, and mail it to Publications Department, Bethlehem Steel Company, Bethlehem, Pa.

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Gentlemen:
Please send me a print of your new film, "Holding Power." I will return it promptly, paying return postage.

Approximate date wanted_____
Send Print to This Address_____
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Name of Company or Organization_____
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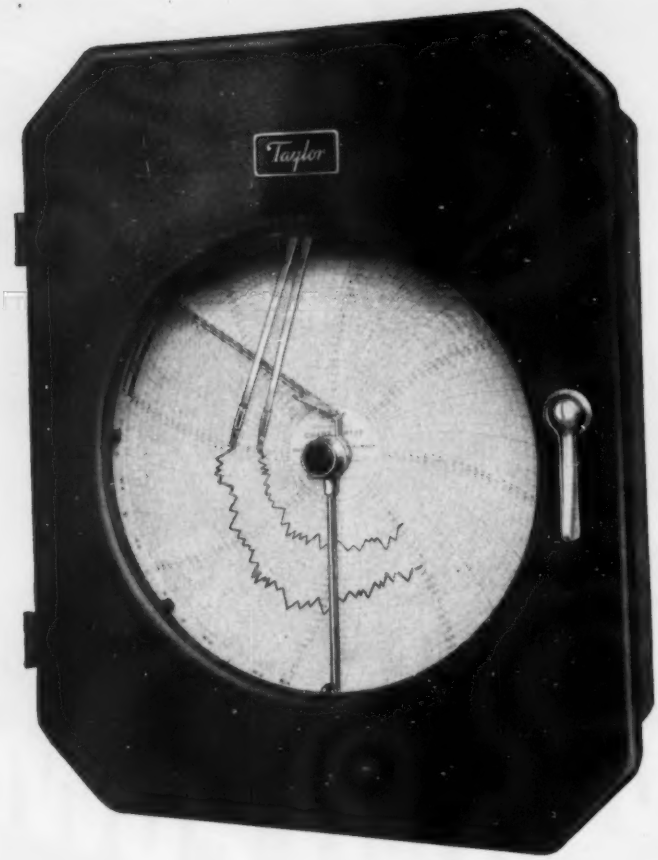
MY-34 Signature_____



"... the Moving Finger writes ..."

". . . and having writ it leaves you an accurate, minute by minute record of temperatures. The Taylor Recording Thermometer gives you a continuous chart record —your best check on the efficiency of both operators and equipment. It indicates when and where waste in heating or cooling media occurs, enabling you to effect improvements in operating conditions and greater operating economy. In addition, a file of chart records helps you trace down faulty operation months after the error has occurred.

Taylor Recording Thermometers come in one, two or three pen models. Two pen recorders are ideal for checking temperature rise or fall between two points in a circulating system such as inlet and outlet brine lines, condensers or other related temperatures in the same or similar units. Three pen recorders are particularly suitable in steam power generation. For example, for recording steam inlet, condensate, and circulating-water outlet temperatures in the operation of a condenser; or flue-gas inlet, flue-gas outlet and air-inlet temperatures on air preheaters.

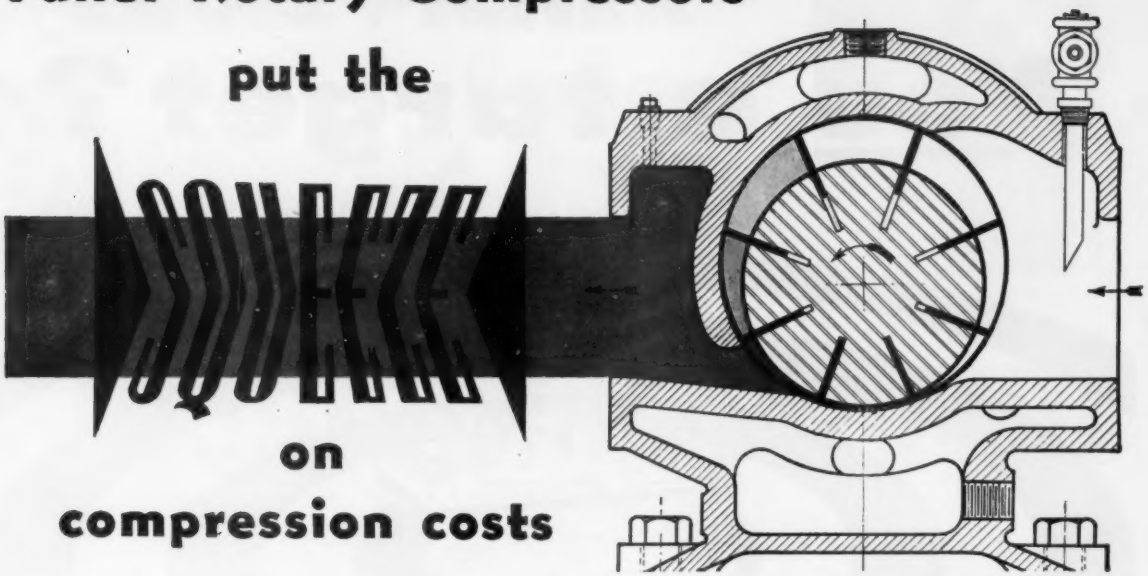
Actuation of these Taylor Recorders is by mercury, vapor, gas or organic liquid, depending on the requirements of the particular application and conditions. In the mercury actuated system Taylor ACCURATUS* Tubing compensates for variations in temperature along the tubing, thus extending the advantages of mercury to applications requiring long lengths of connecting tubing. Its 18-8 stainless steel construction is corrosion resistant to a wide variety of atmospheres, rugged and yet very flexible. Hundreds of standard charts available within the limits of minus 125° to +1200°F. Consult your Taylor Field Engineer for details, or write Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

*Trade-Mark

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

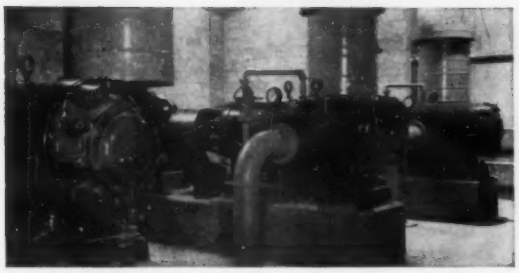
Fuller Rotary Compressors

put the

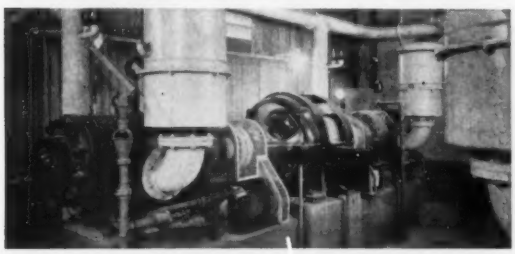


on compression costs

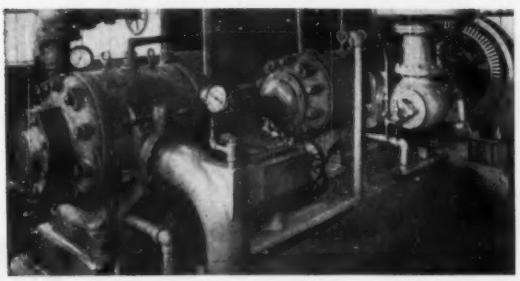
...for pressures up to 125 lb.



Three Fuller Rotary Single-stage Compressors. Capacity each 1400 c.f.m., 19-lb. pressure.



Fuller Rotary Single-stage Duplex Compressor. Capacity 2010 c.f.m., 35-lb. pressure.



Fuller Rotary Two-stage Compressor. Capacity 1665 c.f.m., 100-lb. pressure.

When you consider all the many uses you have for compressed air, you should give careful thought to the best way to get compression with dependability, plus minimum cost and attention —selection of the proper compressor at the required pressures to do the work in the most efficient manner. Fuller builds the compressor that has *earned* a reputation for dependability and long life—for pressures up to 125 psig.

Fuller Rotaries have so many inherent advantages that they warrant your closest examination. Free from reciprocating parts, with no valves to leak or seats to grind, no unbalanced forces to set up vibration, they assure low-cost, smooth-flow operation during their long life. And, they give you *original, maintained capacity*.

Check your compressed-air needs . . . a Fuller engineer, specializing in compressed-air engineering, will give you the *right* recommendation to enable you to produce air efficiently, and at the lowest possible cost. Write now.

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Pioneers of high-efficiency vane-type rotary compressors

You a target?

Let's face it . . . we're all targets!

If your plant is not ready with a disaster plan, better act now. There's not a single American plant that's out of range of an intercontinental bomber—and fires, floods, tornadoes or explosions can kill you just as dead as an atom bomb.

It costs next to nothing to take a few simple steps which may save hundreds of lives. Here they are. Check them off today.

☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

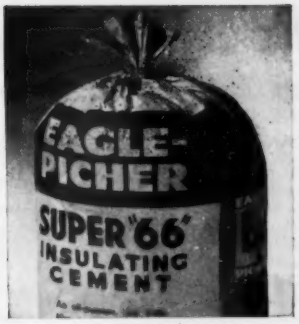
☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

Act now . . . check off these four simple points . . . lives are at stake . . . have you a right to delay?

EAGLE-PICHER

Super "66" Insulating Cement



Conforms to Commercial Standard CS-117

Because Eagle-Picher Super "66" Insulating Cement *really sticks*, it has money-saving advantages that are apparent the minute your crew begins to apply it.

Because *it sticks*—less time is wasted in application—it stays where you put it whether the equipment is heated or temporarily out of service. It "holds together" — usually no reinforcing needed on applications up to 1½ inches thick.

Because *it sticks*—Super "66" can be used effectively, economically on all types of surfaces—flat, curved, overhead—anywhere you need insulation. It's truly an all-purpose cement.

And—Super "66" is rust-inhibitive—cannot cause corrosion–actually helps prevent corrosion of costly equipment.

If you've never tried Eagle-Picher Super "66," it will pay you to learn more about it today!

"Springy Ball" structure—*the secret of the high thermal efficiency of Super "66." These small, resilient pellets of mineral wool, each one honeycombed with thousands of minute air cells, effectively resist the flow of heat even when used on equipment heated to 1800 F.*

Since 1843

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THE EAGLE-PICHER COMPANY

General Offices: Cincinnati (1), Ohio

For greater efficiency, protection and economy, you should investigate these Eagle-Picher products: Insulating Felts • Insulating Block • Blankets • Loose Wool • Mineral Wool Pipe Covering • Stalastic Stamastic • Insulseal • Finishing Cements • Insulating Cements • Swetchek • Insul-Stic • Fireproofing Cement

Member of Industrial Mineral Fibre Institute

It's ELLISON for accuracy!

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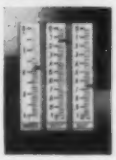

Unit mechanism —readily accessible or removed. Non-parallax pointers. All diafram types have free-floating, long-life diafram. Bell type gages, Bulletin 122—Diafram type, Bulletin 124.

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Unit mechanism readily accessible or removed. One, two or three pointers. Powerful movement on knife edge bearings. Ask for Bulletin 122.

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Constant zero under wide range in room temperature. Level and tube are replaceable in the field. Stationary and portable types. Also accessories and pitot tubes. Ask for Bulletin 109.

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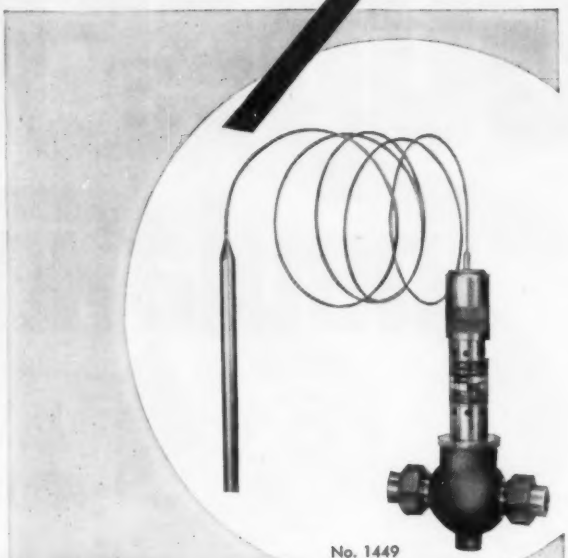
new Klipfel tank thermostat valve



No. 1449

with 7 important advantages..

- LONG LIFE HARDENED METAL BALL INNER VALVE
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- QUICK, UNIFORM THROTTLING ACTION
- POSITIVE, TIGHT CLOSING
- WIDE SELECTION OF TEMPERATURE RANGES
- GENEROUS 50° ADJUSTMENT RANGE

For dependable, low-cost temperature control, select this NEW Klipfel Thermostatic Valve . . . perfected to give the service you want with accuracy, dependability and minimum maintenance. Write for complete details or request literature from your supply house or Klipfel Distributor, listed in the classified telephone directory.

NEW 2 MORE MONEY-SAVING KLIPFEL CONTROLS

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No. 1649 — Combination Temperature and Pressure Control . . . single main valve with temperature and pressure control saves cost and labor!

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Rotating ball seats perfectly . . . is self-cleaning . . . gives streamlined flow!

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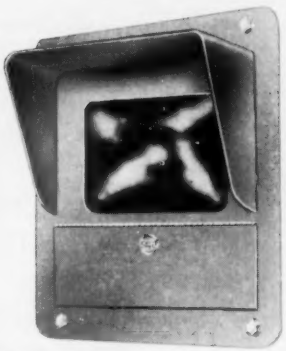
Every **Heavy-Duty Job**

SMALL, RUGGED CAMERA—

only 10½" x 5" x 3½"—goes anywhere—sees with amazing definition—picks up fine meter readings—shows practically any operation or process in detail.

IMPORTANT:
New Low Prices Now in Effect!



PANEL-MOUNTING MONITOR—

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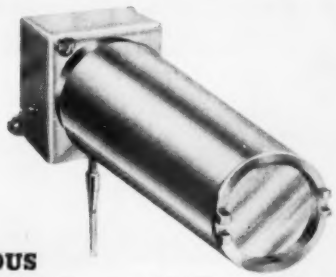
new weatherproof housing protects camera from cold, heat, snow, and rain—makes RCA Industrial TV a true round-the-clock, round-the-calendar instrument.



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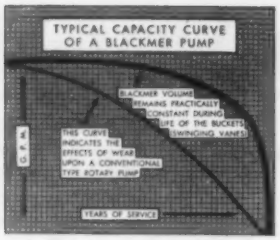
TYPICAL CAPACITY CURVE
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BLACKMER VOLUME REMAINS PRACTICALLY CONSTANT DURING LIFE OF THE BUCKETS OR SWINGING VANES
THIS CURVE INDICATES THE EFFECTS OF WEAR UPON A CONVENTIONAL TYPE ROTARY PUMP
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YEARS OF SERVICE

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4. The Blackmer pressure control valve, an integral part of the pump, provides minimum variation from set pressure and protects the unit against damage by accidental shut-offs in the discharge system.
5. Pumps are available with speed reduction equipment for operation by all types of power drives (Motors, Engines, Turbines, etc.)
6. Blackmer rotary pumps supply the answer to a wide range of LIQUID MATERIALS HANDLING problems involving delivery to 1500 GPM — viscosities through 100,000 SSU — discharge pressures through 150 PSI — temperatures to 600°F.

liquid materials handling

BLACKMER

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VITRALLOY TUBING *Low-Cost solution to*

PREHEATER TUBE outage!

*"Corrosion can be prevented by using materials that are not attacked by sulfuric acid. Special glass appears to offer good possibilities . . ."

Barrows is now producing, and has placed in use, glass coated, long lengths of tubing up to 3" in diameter. Field tests prove long term protection for preheater tubes now possible with glass coatings.

*"Progress in air-preheater design demands that the temperature of the exit flue gases be lowered considerably below those now attained."

Barrows *Vitralloy* preheater tubes will handle lower flue gas temperatures. Lower temperatures mean increased efficiency.

*Reprinted from Bureau of Mines Report of Investigations 4996

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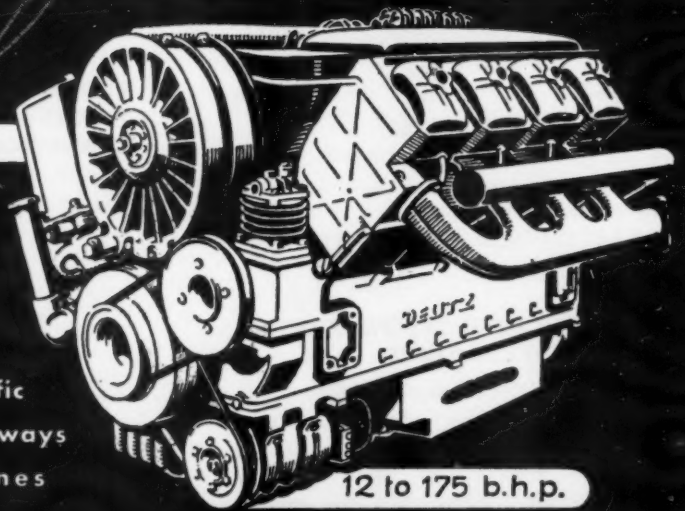
BARROWS PORCELAIN ENAMEL CO.

LANGDON ROAD & PENN. R. R., CINCINNATI 13, OHIO

DEUTZ

Diesel

air cooled



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GERMANY

Badger

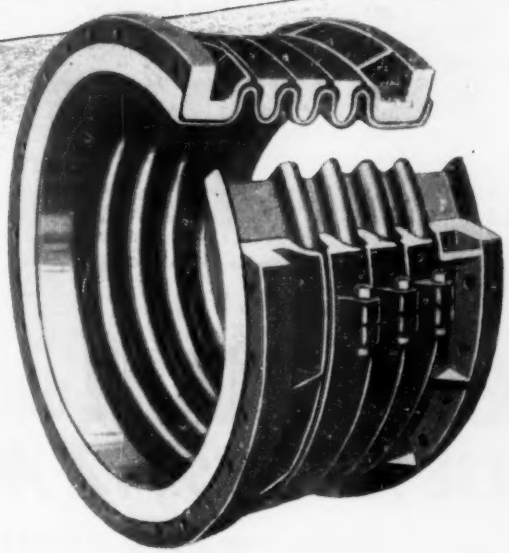
Expansion Joints

Typifying Joint Engineering at its Best

STARTING POSITION
LINE COLD

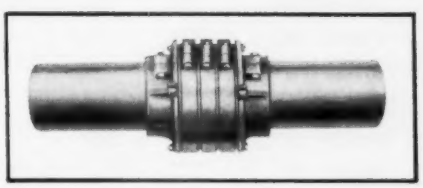
THE CALCULATED CURVE of the EQUALIZING RING

FINAL POSITION
FULL TEMPERATURE



In the Badger Self-Equalizing Expansion Joint, the solid ring between the adjoining corrugations is more than a mere stop or block. It performs a directing as well as a limiting function. It's part of the Directed Flexing control because its specially calculated curved surface causes the all-curve corrugation to wrap itself around the ring. This distributes the flexing evenly over all parts of the corrugations.

Any design of equalizing ring with shoulders will act as a stop to limit the traverse per corrugation but it takes a special calculated curved surface to distribute the flexing properly. The long service life of the Badger Joint is due in large measure to the fact that all-curve rings aid in directing the flexing and in distributing the traverse as well as limiting the movement exacted from each corrugation.



Badger Expansion Joints come in a variety of types and a wide range of sizes: Directed Flexing, Self-Equalizing for normal and long traverses and higher pressures; Non-Equalizing, for short traverse or low pressures. Tandem Joints for combination axial and lateral movements; Clevis-Hinged Joints for angular movements; Special Vibration Control Joints; Flexible Pipe Line Seals for watertight connection between pipes and flood walls.

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Original and Sole Manufacturer of Badger Expansion Joints

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Steamaster
SCOTCH MARINE BOILERS

In heating surface and service, you get more for your money... an exceptional 7 to 8 sq. ft. heating surface per boiler hp.

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STEAMASTER AUTOMATIC BOILER CO.
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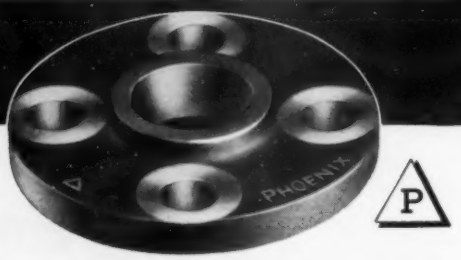
PHOENIX *Drop-Forged* FLANGES MEAN...

MAXIMUM STRENGTH



Long life is assured with Phoenix maximum strength flanges. Forged of mild steel, they are available in a wide range of styles and sizes. Meet ASA requirements and ASME and ASTM specifications.

NEW CATALOG!
Send for free brochure showing Phoenix Complete Line.

FLANGE DIVISION
PHOENIX MANUFACTURING CO.
Catasauqua, Pa. • Joliet, Ill.

Here's proof! ONLY JOHNSTON OFFERS ALL THESE FEATURES *AT NO EXTRA COST!*

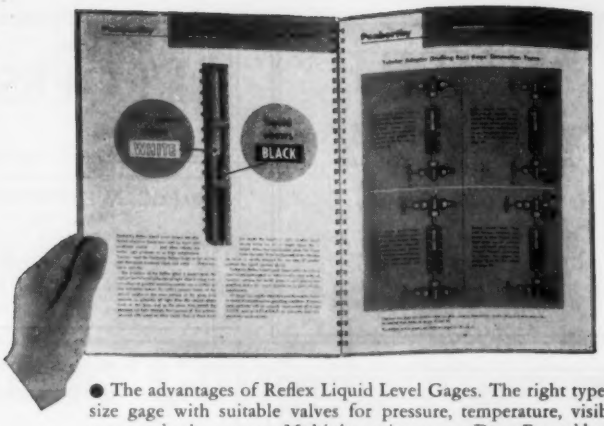
TURBINE PUMP SPECIAL FEATURES—OIL LUBRICATED ENCLOSED IMPELLERS

MAKE	VITRIFORM ENAMEL BOWLS	REPLACEABLE WEAR RINGS	DUAL BOWL BEARINGS BRONZE & RUBBER	SAND COLLARS	PRESSURE SEAL OIL TUBE	NPT SUCTION	COLUMN STRAIGHT THREAD BUTT STANDARD PIPE	VITRIFORM ENAMEL IMPELLERS	DISCHARGE COMPANION FLANGE	1 GALLON OILER WITH SOLENOID VALVE	TRIPLE IMPELLER SEAL
JOHNSTON	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
PUMP "A"	EXTRA CHARGE			YES	YES	YES		EXTRA CHARGE	YES	YES	
PUMP "B"				PART OF IMPELLER	YES	YES			YES	YES	
PUMP "C"	EXTRA CHARGE	EXTRA CHARGE		YES	YES	YES	YES	EXTRA CHARGE	EXTRA CHARGE	EXTRA CHARGE	YES
PUMP "D"	EXTRA CHARGE	REPAIRS ONLY				YES		EXTRA CHARGE	YES	YES	
PUMP "E"	EXTRA CHARGE	END SEAL YES	YES	YES	YES	YES	YES	YES	YES	YES	
PUMP "F"	EXTRA CHARGE	EXTRA CHARGE		YES	YES		YES	EXTRA CHARGE	EXTRA CHARGE	EXTRA CHARGE	
PUMP "G"				SO-CALLED SEAL	YES	YES		YES	YES		
PUMP "H"		CERTAIN SIZES ONLY			YES	YES			YES	1 PINT	
PUMP "I"						YES			YES	1 PINT MANUAL	
PUMP "J"	EXTRA CHARGE			YES	YES	YES	YES		YES	YES	

NOTE: This information taken from available price book and printed literature.

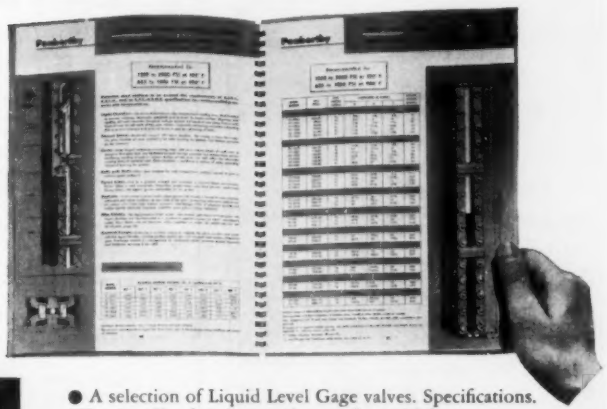
JOHNSTON PUMP COMPANY, 3272 EAST FOOTHILL BLVD., PASADENA 19, CALIFORNIA

FACTS AT YOUR FINGERTIPS



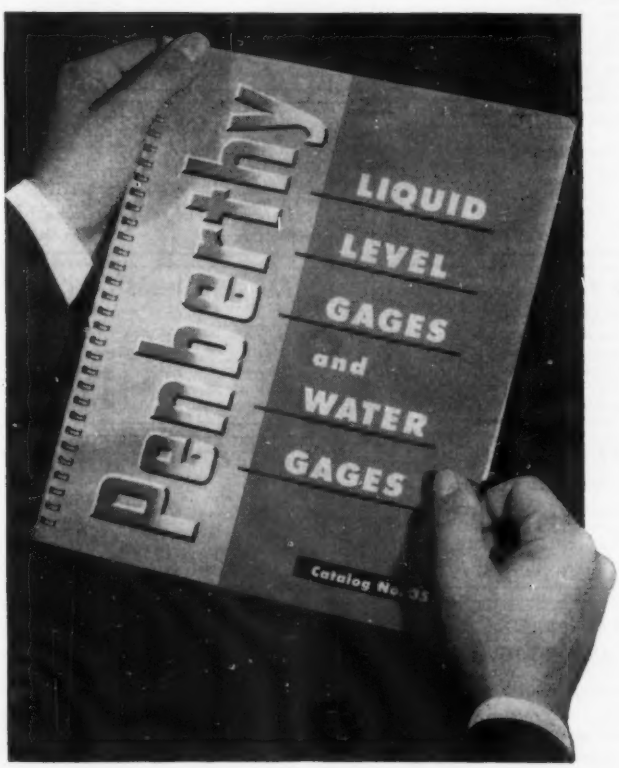
● The advantages of Reflex Liquid Level Gages. The right type and size gage with suitable valves for pressure, temperature, visibility range and valve centers. Multiple section gages. Drop Forged bodies. Pyrex glass. Basic and special designs.

● When to use Transparent Liquid Level Gage Sets. High pressure steam service. Adapters, valves, connections. Types available with recommendations.



● A selection of Liquid Level Gage valves. Specifications. "Floating Shank." Connections and special features.

● Metallurgical specifications. Gage glass and guard rods. Engineering service.



Penberthy's Catalog 35 is jam-packed with illustrated facts and specifications. It is your best guide to selecting the right liquid level gage sets at the most economical cost. In the complete Penberthy line, there are standard products for almost every application. Where your needs are special or unique, use the experience of almost 70 years to solve them. Take a tip from many thousands of satisfied users and write for your copy of Catalog 35.

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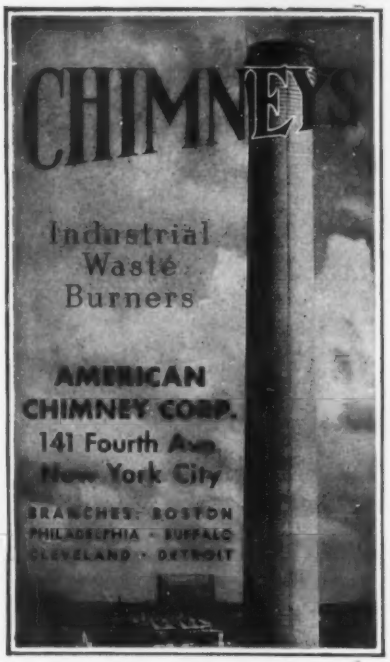
There's *Certain* satisfaction in products by PENBERTHY

WHERE TO BUY

Featuring additional products, specialties & services for power plants



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High Pressure Rubber Gaskets
ALL SIZES TO FIT YOUR GAGES

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

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With FORMULA NO. 640, a clear liquid which penetrates 1" plus in concrete, brick, stucco, plaster, etc. Seals out water, dirt. Holds 20' head. Use outside and in. Preserves all absorbent materials. Sold 14 years. Quick, economical, sure. $3 in 55's. Free sample. See Sweet's.
HAYNES PRODUCTS CO., OMAHA 3, NEBR.

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers — the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

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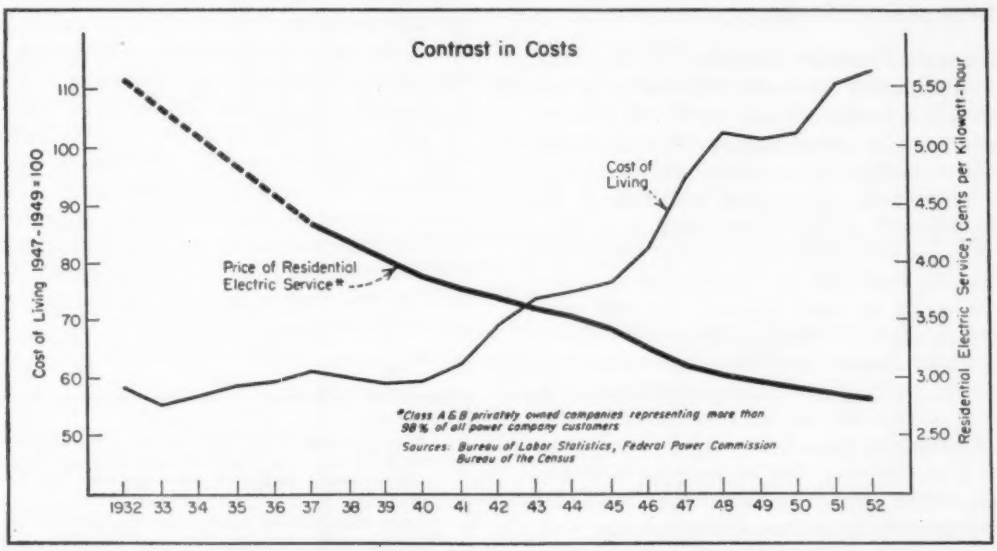
A 20-YEAR RECORD . . .

The Electric Power Companies' Case for Public Confidence

An economic study of the record of the investor-owned electric power companies of the United States over the past twenty years underwrites their claim to public confidence today. A key factor of this record is set forth by the chart in the middle of this page. This shows that while the cost of living as a whole has almost doubled, the average price of electric energy for residential use in the United States has been cut in half.



The average prices of industrial and commercial power also are much lower than they were twenty years ago.

Such a study confirms the record on other key accomplishments of the electric power companies during the past two decades.

They have not failed, either in peace or war, to meet the nation's rapidly expanding electric power requirements. In paying tribute to the performance of these companies during World War II, J. A. Krug, Director of the Office of War Utilities, said, "Power has never been too little or too late." The same can be said for the entire period of the past twenty years.

To be ready with enough power — on time — the electric power companies have expanded their production fourfold since 1933. This has required an investment of over $17 billion in new facilities. To raise the funds for this investment they have enlisted the participation of about 3 million direct stockholders. Through life insurance companies, banks and similar institutions, about 90 million Americans — more than half of the nation's total population — have become investors in electric power companies. By thus relying on private investment for their expansion, the power companies have provided their

plant and operating equipment without burden on the taxpayer.

In addition, the investor-owned companies have paid about $12 billion in taxes to various governments – national, state and local – over the past twenty years. Unlike government-owned and -operated systems, they have received no public subsidies. When taxes and subsidies are taken into account, the rates for electricity charged by the investor-owned companies have been as low as, or lower than, those charged by government-owned and -operated systems.

Many Americans do not appreciate the job that the power companies have done over the past two decades. That is due, in part, to the public memory of financial abuses by some utility holding companies during the 1920's. This memory obscures a clear and unprejudiced view of the progress since those days. And some of the all-out advocates of reliance on government rather than on regulated private enterprise for the development of our power resources do their best to keep this memory of the past alive in the present.

An Impressive Case

Some special cases of electric power development may involve problems for which the investor-owned companies are unable to provide full solutions. This may be true, for example, of some large multiple-purpose projects that combine electric power generation with related developments such as the improvement of navigation, flood control and the irrigation of arid lands. Some of the economic and administrative problems imposed by such projects are not well adapted to effective handling by private enterprise. Flood control and the improvement of navigation, for example, usually involve the provision of much costly service over and above the cost of producing power.

It is true, however, that in some cases development of the electric power side of multiple-purpose projects by private enterprise may well be more feasible than would appear from statements by some government power advocates. And the record indicates that even in those projects on which both the power generation and the other services are handled by public authority, it may well be desirable to have the investor-owned companies assume the transmission and distribution functions.

Our study of the record of the investor-owned and -operated companies over the past twenty years has led us, of course, behind the statistics that bear on the wisdom of giving them a priority in the development of our power resources. It reveals that these enterprises are manned by people who, through lifetime experience, are peculiarly conversant with the needs of the communities they serve. They have given the consumer notably good service while conforming to standards set and enforced by public regulatory commissions. They have won the confidence of the investing public. By their nature and their experience they are competent to handle any power program that can be demonstrated to be economically sound.

The Paramount Public Interest

By their economic performance during the last twenty years, the electric power companies have earned the confidence of the public. By relying on these companies to meet its electric power requirements the public will fully protect its economic interest in ample and efficient service at fair prices.

That is where our study comes out. Our findings do not touch the political consideration that private operation of electric utilities under public regulation is a safeguard against further concentration of both political and economic power in a federal government that already commands too great a concentration. But if these findings make an economic case for preferring power development by tax-paying business as against power development by governmental agencies, they clear the way for an appeal to the paramount public interest in safeguarding our personal and political freedoms against the further encroachment of government.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

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Send detailed resume and salary requirement to:

AMERICAN LOCOMOTIVE CO.
Personnel Department
SCHENECTADY 5, N. Y.

WANTED BY LARGE PAPER COMPANY

in Northern Maine

One Turbine Operator experienced in all phases of operation of medium sized Westinghouse Bleeder type Turbines in a Plant of 20,000 Kilowatts capacity.

One Boiler Room Foreman. Must be experienced in the operation of Pulverized coal equipment. Medium pressure, Water Tube Boilers. Steady work. Retirement Plan. Other Benefits.

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P-1639, POWER
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SALES ENGINEERS, with a knowledge of steam boiler operation and maintenance and experience in selling to the industrial heating and power plant trade, are wanted for permanent service in choice territories in various states. Assignment involves the sale of a combustion type triple action fuel oil conditioner, to commercial and industrial plants. High income arrangement on initial and repeat orders assures good substantial year 'round earnings. Address applications to KOR Division, Dept. GW, P.O. Box 485, Gary, Indiana.

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(Continued on the following page)

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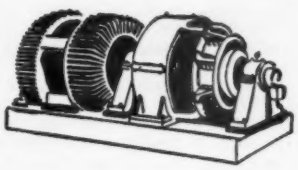

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c/o POWER
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NO CHARGE • NO OBLIGATION

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Please help us locate the following used equipment:

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NAME ..... TITLE.....

COMPANY .....

STREET .....

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4/54

MOTORS • GENERATORS • TRANSFORMERS

3 PHASE 60 CYCLE 220/440 VOLT

HP	Make	Type	Speed
10	F.-M., 2 Speed	H-12B	690/1200
10	G. E.	KT-502	880
10	Cr. Wh., BB	SC-ALH 365	885
10	Allis Ch.	AR	1200
10	G. E.	KT-300	1200
10	G. E.	K-326	1200
15	West., New, Vert., BB	CW-404	900
15	G. E.	IK	700
15	G. E.	KT-312	900
15	G. E.	K-312	900
15	Cr. Wh.	SC	900
15	U. S., BB	FRB-482	1200
15	Reliance	IH	1200
15	G. E.	K-326	1800
15	L. Allis, TEFCOB, Ex. Pr.	EX-384	1700
15	G. E., Special	KF	3480
15	G. E., Var. Speed	IK	1800/600
20	West.	MS	900
20	G. E.	I	900
20	Wagner	BP-18T	1140
20	West.	CS	1150
20	West., New, BB	CS-383	1170
20	L. Allis, TEFCOB, Ex. Pr.	ES-365	1800
25	G. E., Slip Ring	I-M	685
25	G. E., New	K-405	900
25	G. E.	IK	1200
25	Allis Ch.	AR	3600
30	Wagner, Slip Ring		1200
30	G. E., Slip Ring	MT-523	1800
35	West., Slip Ring	CW-785	585
40	Cr. Wh.	1210	685
40	Lincoln	IM	720
40	West.	CS	1160
50	West.	CS	900
50	G. E.	K-304	1200
50	F. Morse	12-B	1725
50	F. Morse	H	1750
50	Ideal, New, TEFCOB	A-B	1800
60	West., TEFCBB, Ex. Pr.	CS-607	875
75	West., Slip Ring	CW	900
75	G. E.	KT-356	885
75	F. Weinchel, Synch.	28Y-RN	1200
100	West., Slip Ring	CW	435
150	G. E.	KT-5585	875
200	G. E., Slip Ring	IM	600
200	G. E., Synch.	2300 volt	225
350	G. E., Synch.	4800 volt	225

25 CYCLE MOTOR SPECIALS

1— 40 HP Reliance TEFC BB 3/25/220/440/1500 RPM.

1— 50 HP Fairbanks Morse BB 3/25/220/440/750 RPM.

1—100 HP Gen. Elect. Type KT 553 3/25/440/1445 RPM.

1—100 HP Gen Elect. Type KT 5595 Ball Bearing 3/25/440/1465 RPM.

2—150 HP Gen. Elect. Type KT565 TEFC BB—3/25/440/750 RPM.

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60-50-25 Cycle In Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM.

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

400 HP GEAR REDUCER

1—400 HP Nutall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

400 H.P. COMPENSATOR

400 H.P. Westinghouse reduced voltage, manually operated synchronous motor starter—Unity P.F.—3/65/2300 Volts—Complete.

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1—55" Cutler Hammer Magnet 250 Volts DC. Excellent Condition.

125 VOLT DC MOTOR

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole
1—1600 AMP. Condit. 2 Pole
1—1600 AMP. Westinghouse 2 Pole
1—3000 AMP. Westinghouse 2 Pole

TRANSFORMERS

1—750 KVA Niagara, New. Outdoor 3/60/2400/208Y/120

1—300 KVA Niagara, New. Non-inflammable Liquid. 3 Phase, 60 Cycle 4160 V. Prim. 480 V. Secondary, Primary Fused Cutouts, Secondary Junction Box. Immediate Shipment

1—75 KVA G.E. Dry Type 1/60/440 V. Primary 220 V. Secondary

6—50 KVA Niagara. New. Dry Type 1/60/240/480-120/240

1—20 KVA G.E. Dry Type. 1/60/480 V. Primary, 120 V. Secondary

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(Continued from preceding page)

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AC MOTORS

Qu.	HP	Make	Type	Volt	Speed
1	150	Westinghouse	CS	220–440	1750
1	125	Westinghouse	CCL	2200	1140
1	100	American		220–440	1750
1	75	A. C.	AR	220–440	1750
1	60	Woods	B	220–440	1200
1	60	Westinghouse	CS	220–440	690
5	40	Reliance	AA	220–440	1140
2	40	Wagner	6PI	220–440	1160
1	40	Westinghouse		440	690
1	30	General Electric	KF	220–440	1760
1	30	Reliance	AA	440	1150
1	30	General Electric	K	220–440	1170
1	30	Crocker Wheeler	SC	440	1800

AC SLIP RINGS

112	G. E.	ITC 5015	220–440	495
75	A. C.	ARY	220–440	1750
60	G. E.	MT 343	220–440	1200
50	G. E.	MT 343	220–440	1200
50	G. E.	MT 336	220–440	1200
50	West.	CI 654D	220–440	690
40	Howell	SR 504	220–440	900
40	Howell	SR 504	220–440	900

SYN MOTOR

75	West.	G	440	720 Dir. Con. Exc.
50	G. E.	TS7558	440	1200 Dir. Con. Exc.
40	G. E.	TS7542	440	900 Dir. Con. Exc.

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200 KW	Ideal	240	3–60	327

VENN-SEVERIN Model M Engine

125 KW	Ideal	240	3–60	327

TRANSFORMERS

3—1000 KVA	G. E.	13,800	6900 1 ph. 60 cy	
5— 100 KVA	Mol.	220 volt	11–11–12–14 16–18–20	
1—75 KVA	G. E.	13,200	120–240 1 phase	
2—50 KVA	G. E.	12,000	120–240 1 phase	
1—50 KVA	West.	7,200	120–240 1 phase	
6—25 KVA	G. E.	440–110	1 phase Dry Type	
1—37½ KVA	Penn.	1,200	120–240 1 phase	
1—37½ KVA	West.	7,200	240–120	
1—37½ KVA	West.	6,900	115–230	
10— 5 KVA	—West.	13,800	115–230	

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A. C. MOTORS

3 ph. 60 Cycle SYNCHRONOUS

Qu.	HP	Make	Type	Volts	Speed
1—	4350	Cr. Wh.		4160/13800	514
2—	3500	G. E.	TS	2300	257
1—	2500	G. E.	ATI	2300	720
2—	2100	G. E.	ATI	2300	360
2—	2000	Whse.		2300	120
1—	2000	G. E.	ATI	2200	900
2—	1750	G. E.	ATI	2300	3600
3—	735	G. E.	ATI	2200/12000	600
1—	720	G. E.	TS	2200	720
1—	500	Ideal	SM	2300/4150	1800
1—	450	Whse.	Eng.	2200	128.5
1—	450	Whse.		2300	450
1—	400	G. E.	TS-6424	2200	400
2—	350	G. E.	TS	2200	150
1—	300	Whse.		2300	720
1—	150	Whse.		440	600

SLIP RING

1—	1500	G. E.	MT-498	2300	360
1—	1500	ABB		2300	720
1—	1200	G. E.	MT-26	2300	275
2—	1000	A. C.	Mill	2300	240
1—	1000	G. E.	MT-452	2200	321
1—	500	Whse.	CW	550	360
1—	500	G. E.	M-574Y	2200	900
1—	450	G. E.	IM	440	720
1—	400	Whse.	CW-1218	2200	435
1—	400	Whse.	CW	440	514
1—	400	Whse.	CW-960A	440	1170
1—	350	G. E.	MT-442	2300/4000	253
1—	350	G. E.	IM-17A	440/2300	720
1—	250	G. E.	MT-424Y	4000	250
1—	250	G. E.	MT-559S	2200	1750
1—	250	A. C.		550	600
1—	200	Cr. Wh.	26QB	440	505
1—	200	G. E.	IM	440	435
1—	200	G. E.	MTP	440	1170
1—	150 new	Whse.	CW	2300	450
1—	150	G. E.	IM-16	440	600
2—	125	A.C.		440	865
1—	125	A. C.		440	720
4—	125	G. E.	MT-566Y	440/2200	435
2—	100	G. E.	IM	440	600
1—	100	G. E.	IM	2200	435
4—	100	A. C.		440	695
4—	100	G. E.	MT	440/2200	435

SQUIRREL CAGE

2—	650	G. E.	FT559BY	440	3570
2—	450	Whse.	CS	2300/4150	354
1—	300	Whse.	CS	440	1170
1—	200	G. E.	IK-17	440	580
3—	200	G. E.	KT-557	440	1800
1—	75/150	G. E.	IK	440	450/900
1—	150	Whse.	CS	440	580
1—	150	Wstghse.	CS856S	440	880
1—	125	Whse.	MS	440	485
2—	125	Al. Ch.	ARW	2200	1750
2—	100	G. E.	IK	440	580
1—	100	Whse.	CS-TEFC	208	720

D. C. MOTORS

Qu.	HP	Make	Type	Volts	Speed
1—	2200	G. E.	MCF	600	360/500
1—	2000	Whse.	Mill	600	230/460
1—	940	Whse.	QM R Brg.	250	140/170
1—	900	Whse.		250	450/550
1—	925	Whse.	Mill	250	90/180
1—	600	A. Ch.	Mill	230	400/800
1—	500	Whse.	Mill	600	300/900
2—	450	Whse.		550	415
1—	400	G. E.	MCF	550	300/1050
1—	300/400	G. E.	DYNA	250	1325/2500
1—	300	Whse.	CB-5094	230	575/1150
1—	200/300	G. E.	MPC	230	360/920
1—	250	G. E.	MPC	230	400/500
1—	200	Rel.	1970T	230	720
1—	200	Whse.	CB-5113	230	400/800
1—	150	G. E.		600	250/750
8—	150	Cr. Wh.	83H	230	890
1—	150	Cr. Wh.	CMC-65H	230	1150
1—	150	Whse.	SK-201	230	360/950
1—	150	Whse.	SK-151B	230	900/1800
1—	125(new)	Whse.	SK-183	230	850
1—	125	G. E.	MDS-416	230	415
1—	75	C. W.	53H-TEFC	230	860
1—	75	Whse.	SK-170	230	600/1200
1—	50/120	G. E.	MFC	230	250/1000
2—	100	Whse.	SK-181	230	450/1000
4—	50	El. Dy.	25-S	230	525/1050
2—	50/60	Whse.	SK-170	230	400/1200
1—	50	G. E.	CO-1810	230	725
1—	50	Whse.	SK-170	230	350/1050
1—	50	G. E.	RCP-31B	230	1700
2—	40/50	G. E.	CD-135	230	300/1200

MOTOR GENERATOR SET

3 Ph. 60 Cycle

Qu.	KW	Make	Speed	D. C. Volts	A.C. Volts
1	3000(3U)	G. E.	514	600	4000/13200
1	2000	G. E.	514	600	13800/4000
2	2000	G. E.	450	250	2400
1	2000(25cy)	G. E.	500	660	6600/11000
2	1750	G. E.	514	250	2400
1	1500	G. E.	720	600	6600/13200
1	1500	C. W.	514	115	4160/13800
2	1000	Whse.	900	600	2300/4100
1	1000	G. E.	900	260	6600
1	1000(3U)	G. E.	900	250	2400/4800
2	750	Whse.	900	275	2300/4160
1	750	C. W.	514	115	2300
1	600	G. E.	720	250	440/2300
1	600	Whse.	900	125/250	440
1	500	Whse.	1200	125/250	2300
1	500	G. E.	720	125	2300/4000
1	400	G. E.	720	250	440/2300
1	150	Whse.	1200	600	2200
1	150	G. E.	1200	250	2300
1	150	Whse.	1200	275	2300
1	150	G. E.	1175	125	440
1	140(3U)	Cr. Wh.	690	125-250	2300
1	125	G. E.	1200	125	440
1	100	Delco	1200	125/250	440
1	100	G. E.	1200	250	2300/4000

12,500 KW 60 to 25 CYCLE FREQUENCY CHANGER—IMMEDIATE SHIPMENT

Westinghouse 300 R.P.M. 4 Bearing frequency changer set. Motor 17200 H. P. .7 P.F., 13200 Volt, 3 ph., 60 cy., Generator 13900 K.V.A., 12500 KW .9 P.F. 13200 volt, 3 phase, 25 cycles, with 2 direct connected 125 volt exciters, complete including motor operated phase shifter, air washer; 60 and 25 cycle controls—Prints, performance guarantees and complete details available—Can be inspected in operation.

FREQUENCY CHANGERS

Qu.	KW	Make	Cycles	Voltage
1—	3000	G. E.	25/60	4000/2300x2300/4000
1—	2500	G. E.	25/60	2400x4150
1—	2000	G. E.	25/62½	2300/4160
1—	2000	Whse.	25/62½	2300/2300
1—	1000	G. E.	25/58	4400/2300
1—	500	A. C.	25/60	11000/2300V

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G. E.	Condensing 425 — 750°F.T.T Surface Condenser 3/60/2300/4000V Direct conn exciter
1	1500	Whse	Auto-extraction 190 lbs.—600°F.T.T. 60 lb. extraction 3/60/240 V. Dir. conn. Exc.
1	1000	Moore	Auto - Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300.
1	1000	G. E.	Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60.
1	750	G. E.	Condensing 265# I.S.P. 440V.3 ph., 60 cy.—New—1944.
1	750	Whse.	—No n-condensing 135# I.S.P 40# B. P. 750 Kw. 280 V. D. C.
1	500	Moore	Non-condensing—150/200 lbs. I S.P. 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter.
1	300	G. E.	Non-condensing 10/175# I. P 5/15# B.P. 480V. 3 ph. 60 cy

TRANSFORMERS

60 CYCLES

Qu.	KVA	Make	Type	Ph	Voltages
1	5000	Whse.	OISC	3	33000x26400/13200
1	2500	Whse.	OISC	3	26400/13200x460
3	2000	G. E.	HVDDJ	1	66000x13800
3	1000	G. E.	H	1	2200x480
1	1500	G. E.	HT	3	13200x2300
1	1500	G.E.Pyranol	Auto	3	4400x4000
3	1250	G. E.	H	1	6600x550
1	1000	Pitts.	OISC	3	26400/13200x2400
2	1000	Pitts.	OISC	3	2300x460
4	1000	Al. Ch.	OISC	1	2300/4000x480
3	1000	Wagner	OISC	1	13200x220/440
1	300	Kuhl	OISC	3	13800x460
3	200	Whse.	OISC	1	13200x120/240
3	150	Whse.	OISC	1	33000x2300/4000
3	150	G. E.	HKR	1	13200x2300/4000
3	100	Whse.	S	1	480/120/240

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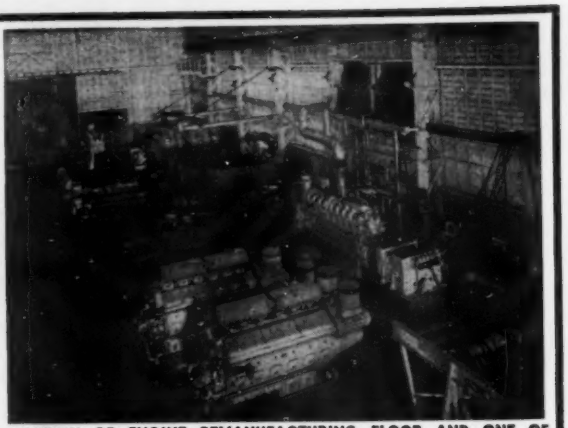

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A PARTIAL LIST OF OUR INVENTORY

KW	MAKE	MODEL	HP	RPM
1180	Worthington	SEH-8	1685	360
1136	Fairbanks Morse	38D	1600	720
1100	General Motors	16-278A	1600	720
750	General Motors	12-567	1080	720
700	Worthington	EE-8	1000	327
600	General Motors	12-567	900	600
*500	General Motors	8-278A	750	720
*500	Alco	6-12½x13T	750	600
500	General Motors	8-567	720	720
*480	Worthington	DD-8	700	360
*400	Ingersoll-Rand	S-8	600	720
*400	Sterling	VDS-8	600	1200
*350	Baldwin	VO-6	510	450
320	Superior	60-S-6	460	450
*320	Enterprise	DSG-6	460	450
300	General Motors	8-268A	450	1200
200	General Motors	8-268A	350	900
*160	Buckeye	80	240	600
150	Fairbanks Morse	338-17	225	300
*150	Worthington	CC-4	225	450
150	Ingersoll-Rand	S	255	600
100	General Motors	3-268A	150	1200

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STANDARD AND SPECIAL VOLTAGES AS REQUIRED
*—*indicates NEW unit.*

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DIESEL ENGINES AND GENERATORS

1—600 HF McIntosh & Seymour #2089; 7 cylinders; driving Allis-Chalmers AC generator #6039; 2200 volts; 45.5 amps; 3 phase; 60 cycle; 900 RPM; driving GE DC generator; 30 KW; 240 amp; Type CD123; Form AL; 575 RPM; 125 volts; Model #3Y221; Serial 1581202; connected to GE DC generator 5 KW; #1226803; Type RC; 125 volts; 1150 RPM

1—McIntosh-Seymour Engine, Type 4A38; #1559; 500 HP; 164 RPM; driving 1 GE DC generator; 30 KW; #1263869; 125 volts; 240 amp; 925 RPM

1—McIntosh-Seymour Engine, Type 4A38; #1763; 500 HP; 164 RPM; driving GE AC generator; #551380; Type AT144; KVA 438; 164 RPM; Form A; 2400 volts; amparm. 105.5; PF .8; 350 KW Model #33A10; 48 amp; 115 volts

1—McIntosh-Seymour Engine, Type 4A38; #1671; 500 HP; 165 RPM

1—McIntosh-Seymour Engine, Type A38; #1672; 500 HP; 164 RPM

1—McIntosh-Seymour Engine, Type A38; #1557; 500 HP; 164 RPM

1—McIntosh-Seymour Engine, Type 4A38; #1673; 500 HP; 164 RPM

Prices on Above: Engines $5.00 H.P.—Generators $5.00 KW or KVA.

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200 KW General Motors Model 8-268A, 8 cyl., 3/60/440 volts, 1200 RPM. Inc. Panel.

100 KW General Motors Model 3-268A, 3 cyl., 360/440 volts, 1200 RPM. Inc. Switchboard.

60 KW General Motors Model 6-71, 6 cyl., 2 cycle, direct current, 125 volts, 1200 RPM.

Overhauled, ready to ship. Other sizes in stock.

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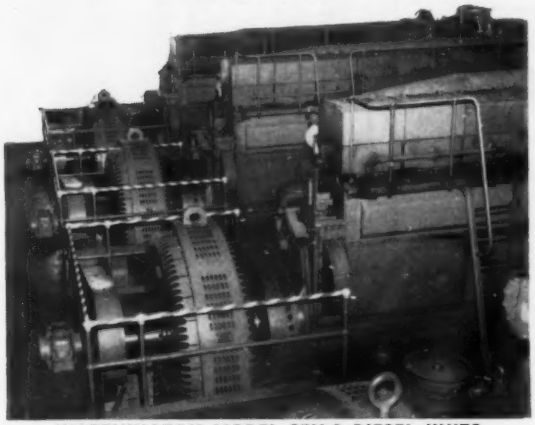

WORTHINGTON MODEL SEH-8 DIESEL UNITS

LATEST TYPE—CURRENT MODEL PRACTICALLY NEW

CAN BE INSPECTED AND TEST RUN . . . CONVERTIBLE FOR DUAL FUEL OPERATION . . . WILL BURN HEAVY FUELS . . . ONE YEAR GUARANTEE

3—1180 KW WORTHINGTON MODEL SEH-8 DIESEL UNITS

ENGINES: Each rated 1685 BHP at 360 RPM turbocharged having 8 cylinders arranged vertically in-line, 16" bore, 20" stroke, 4 cycle, solid injection.

GENERATORS: Westinghouse each rated 1180 KW, 1475 KVA for 2400/4160 or 480 Volts, 3 phase, 60 cycle service.

SWITCHGEAR: Metal-clad type manufactured by Westinghouse with draw-out type air circuit breaker.

50 CYCLE RATING 984 KW AT 300 RPM

UNIT AUXILIARIES: Each unit complete with filters, strainers, pumps, gauge board, pyrometer, thermocouples, lube oil cooler, jacket water cooler, cooling tower, exhaust muffler, intake filter silencer, expansion tank, fuel day tank, flexible piping for intake and exhaust and all station piping, flanges, valves, gauges and fittings for intake, exhaust, water, lube oil and fuel oil systems.

ALSO

1—700 KW Worthington diesel unit with same auxiliaries and accessories as above.

This equipment affords you a rare opportunity to procure complete, modern, latest design diesel units at substantial savings. It represents an offering of heavy duty slow speed diesels which cannot be duplicated by anyone in the diesel field.

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Other Modern Diesel Sets from 2000 KW to 15 KW in STOCK—All Owned and Offered Exclusively by "America's Largest Source of New and Remanufactured Diesel Power"

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B&W type H-3 Sterling #14 Boiler, 250 HP with stoker, flow meter, combustion control, piping, valves, electrical equipment, etc. Also, steel stack, breeching, feed water heater and boiler feed pump.

All new summer 1946

Address inquiries

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ELECTRICAL EQUIPMENT

REBUILT N.I.S.A. STANDARDS

AC Motors — 3 phase 60 cycle

HP	Speed	Make	Wdg.	Type & Disc.	HP	Speed	Make	Wdg.	Type & Disc.
200(3)	1800	West	Syn. 2200 V.	PedBrg'V/Exc	75	900	West.	SR	CW-752C
150	1800	AC	SC 2200 V.	AW-8B	75	600	GE	SR	IM
150	1800	AC	SC 2200 V.	AW-8B	75	600	GE	SC 2200 V.	KT-558
300	1800	West	SC	CS-TEFC Exp. Pr.	60	1200	West.	SC	CB505 Spl. Pr.
150(2)	900	GE	SC 2200V	KF-558	60(3)	1200	Allis-Chal.	SR	ARY-505 BB
150	1800	GE	SR	M-6328 TEFC	50	1800	FM	SR	HV-BB
150	720	Allis-Chal.	SR	AR Hoist	50	1200	GE	SR	MT-336
150	750	GE	SR (25 cy)	IM	50	720	CW	SC	SC
125	1200	AC	SR	ARY-BB	50	600	CW	SR	SR
125(3)	900	West	SC 2200V	CS-856-C	40	3600	GE	SC	K-405aExp.Pr.
100	720	West	SR	CW-513	40(2)	1200	Rel.&West.	SC	Fr. 445-RB
100	900	GE	SR	MT-8B	40(2)	1200	AC&Rel.	SC	TEFC-BB
100	700	West.	SC	CS-8BB	40	900	West.	SR	CW
100	725	Allis-Chal.	SR (25 cy.)	ARY-3 Brg.	40	720	AC	SR	ANY
100	900	GE	Syn 2200 V.	TS-DC Exciter	30(3)	1800	AC	SC	ARZ-TEFC
75	1200	GE	SC	K-TEFC BB	30	1200	AC	SC	ARZ-TEFC

SPECIALS

2—333 KVA Penn. Transformers OISC 1/60—13800/2300.
1—500 KVA Trans. West'hse Type ASL. 5% Imp. 13800/480 volts 75° Air Cooled. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 2—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount —Freight allowed. **SEND US YOUR INQUIRIES.**

NATIONAL ELECTRIC SERVICE CO.

321 Lombard St., St. Louis 2, Mo. Phone — Chestnut 4603

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DIESEL GENERATOR SETS

3—75K2A C.W., 120/208 V., 3 Ph., 1200 RPM. V Belt. to KRUPP. 3C1/L., 2 cy. solid injection complete.

TRANSFORMERS—60 Cycle

Qu.	KVA	Make	Type	Ph	Voltages
1	1000	G. E.	Auto	3	4150x2400
2	750	G. E.	HT	3	4150x120/240
2	750	G. E.	H	1	4600-120/240
1	500	Kuhl.	OISC	1	4150x2400
2	400	Pitts	OISC	1	4800/4150/2400 x240/480
3	333	Whse.	OISC	1	2400x575
1	333	G. E.	H	1	13200x220/440
2	300	G. E.	H	1	13200x440
4	200	G. E.	H	1	13200x440
1	200	G. E.	HT	3	2400x240
2	150	Pitts	ODSC	1	240x120/240
3	50	G. E.	H	1	4800x120/240
3	50	A. C.	H	1	230x120/240
1	25	G. E.	H	1	460x120/240

SLIP RING MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
2	500	G. E.	1200	M	2400/4150
1	400	Whse.	450	CW	550
1	250	Whse.	600	CW	440
1	200	Whse.	600	CW	440
1	200	G. E.	600	MT	440
3	150	A. C.	1800	AY RW	2300
1	100	G. E.	1800	IM	220
1	100	G. E.	600	IM	440
1	75	G. E.	600	IM	440
1	60	G. E.	1800	MT	220

DC, 230 VOLT MOTORS

Qu.	H.P.	Make	Speed	Type
1	300	G. E.	1200	MPC
2	150	C. W.	900	WP
1	125	G. E.	1700	RC
2	75	C. W.	900	WP
1	30	C. W.	700	CM
1	35	G. E.	860	RC
1	25	Whse.	835	SK

WESTINGHOUSE M.G. SET

1000 KW, 600V D.C., 2400/4160Y, 720 RPM, 3 Ph., 60 Cy., 7 PF Syn. Motor. Direct Connected Exciter, Motor Driven Rheostats, Switch Boards, all for full automatic operation.

SQUIRREL CAGE MOTORS

Qu.	Make	Speed	Type	Volts
150	G. E.	720	KT	440
125	G. E.	3560	KF	2300
100	G. E.	1200	FTR	220
75	Ideal	1200	AT	220/440
60	G. E.	1200	KT	220
50	G. E.	3560	FT	220
50	G. E.	600	KT	440
40	G. E.	3550	FT	440
30	G. E.	600	KT	440

MOTOR GENERATOR SETS

Qu.	KW	Make	Speed	DC	AC
1	1000	G. E.	514	600	2300/4150 Syn
1	1000	Whse.	720	600	2300/4150 Syn.
1	1000	Whse.	720	275	2300/4150 Syn.
1	300	C. W.	1200	230	3-unit 2400/4150SR
1	300	G. E.	1200	230	2400/4150SR
1	200	Whse.	900	250	2300/4150 Syn.
1	150	C. W.	1200	250	440 SC
1	150	3 Unit G. E.	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	C. W.	1200	125	2300 S.C.
1	100	G. E.	900	250	2300 Syn.
3	60	G. E.	1200	125	208 Syn.
2	30	G. E.	1200	125	440 SC

SYNCHRONOUS MOTORS

Qu.	H.P.	Make	Speed	Type	Volts
1	300	El. Mach.	720	TEFC	2200
3	200	Whse.	720		4150
1	175	G. E.	720	ATI	2300
1	150	G. E.	720	ATI	2300
1	150	G. E.	1800	TSI	220
1	150	Whse.	900	ISIG	220

OIL CIRCUIT BREAKERS

3—600 AMP. G. E. FKR-55-20, 15,000 V. 3 P. 100,000 KVA, SOLENOID OPER.

1—600 AMP. G. E. FK-143, 15,000 V. 3 P. 50,000 KVA., Manual with Disconnects, Metal Clad Enclosure.

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PHONE NEW JERSEY - UNION 7-1161

Member of The National Industrial Service Association, Inc.

SQUIRREL CAGE MOTORS

Qu.	HP	RPM	Make	Type & Frame	Bearing
1	150	3600	West.	CS-6756H	SB
2	150	1800	West.	CS-771-1-S	BB
1	100	720	G.E.	I	SB
2	75	1800	G.E.	K-505S	BB
1	75	1800	West.	CS-505	BB
1	75	870	G.E.	KT-352	SB
1	60	1750	A-C	26C	SB
1	60	1200	West.	CS-505	BB
1	50	1800	West.	CS-445	SB
2	50	1800	Century	AS-35	SB
1	50	1750	A-C	235	SB
1	50	720	G.E.	KT-546	SB
1	50	720	G.E.	KT-346	SB
1	50	600	G.E.	S	SB
1	40	3500	A-C	AR-416NG	BB
1	40	1200	West.	CS-658A	SB
1	40	1200	F-M	B-H12G	SB
1	40	900	G.E.	KT-336-8	SB
1	40	900	A-C	26C	SB
1	40	865	A-C	23H	SB
1	40	690	A-C	AR	SB
1	32	1200	W-E	KT-532-S	SB
2	30	1200	G.E.	KT-326	SB
1	30	1200	West.	CS-642S	SB
1	30	1200	A-C	72067	SB
2	30	900	G.E.	KT-532	SB
1	30	90	G.E.	44320	SB

DC MOTORS

Qu.	HP	RPM	Make	Winding	Bearing
1	10	1800	F-M	230 v. Comp.	BB
1	10	1800	West.	230 v. Comp	SB
1	10	1700	West.	230 v. Shunt	SB
1	10	1250	G.E.	115 v. Shunt	SB
1	7½	1800	Century	230 v. Comp.	BB
2	7½	900	G.E.	230 v. Series	BB
1	7½	800	Imperial	115 v. Comp.	SB
1	7½	750	G.E.	230 v. Shunt	SB
1	5	1800	Emerson	230 v. Comp.	SB
1	5	1800	G.E.	230 v. Shunt	SB
1	5	1800	West.	230 v. Shunt	SB
1	5	1800	G.E.	230 v. Shunt	SB
1	5	1800	Elec. Dyn.	230 v. Shunt	BB
1	5	1800	Star	230 v. Comp.	BB
1	5	1400	F-M	115 v. Shunt	SB
1	3	1800	Century	230 v. Comp.	BB
1	3	1800	G.E.	230 v. Comp.	SB
1	3	1800	A-C	110 v. Shunt	SB
3	3	1200	G.E.	115 v. Series	SB

OUTDOOR OIL CIRCUIT BREAKERS

Qu.	Amps.	Volts	Make—Type
1	1200	15 KV	G.E. FHKO-236
1	600	110 KV	G.E. FKO-136
1	600	15 KV	West.—0221
1	600	15 KV	Condit O1
1	400	73 KV	West—G1
2	400	37 KV	G.E. FKO-136
1	400	37 KV	West. 0221
2	400	15 KV	G.E. FKO-37

TRANSFORMERS
DISTRIBUTION 1 Phase 60 Cycle

3—3333 KVA 66000 to 33000 & 13200 v.
2—1000 KVA 13200—2300 v.
3— 500 KVA 38100/66000Y—2300 v.
3— 500 KVA 33000 v.—2300 v.
4— 500 KVA 13200 v.—2300 v.
4— 200 KVA 33000 v.—2300/4160Y
5— 200 KVA 13200—2300/4160Y
1— 200 KVA 12000—2300/4160Y
3— 200 KVA 7620/13200Y—2300
1— 150 KVA 66000—2300/4160Y
14— 100 KVA 33000—2300/4160Y
9— 100 KVA 13200—2300/4160Y
6— 100 KVA 7620/13200Y—2300/4160Y
3— 75 KVA 460—120/240
3— 75 KVA 2400—230/460
2— 50 KVA 60000—2300 v.
1— 50 KVA 6600/11400Y—2300
3— 50 KVA 13200Y—2300 v.
1— 25 KVA 13200Y—240/480
1— 25 KVA 7200/12470Y—240/480
3— 25 KVA 400/4160Y—120/240
3— 25 KVA 2400—230/460
8—15 KVA 67—5 KVA
62—10 KVA 26—3 KVA
71— 7½ KVA 15—1½ KVA

TRANSFORMERS
OUTDOOR INSTRUMENT

2—110000/66000—110 v. 200 VA West. P.T.
3—34500—115 v. 200 VA West. P.T.
9—33000—110 v. 200 VA GE P.T.
2—60/120—5A 37KVA G.E. C.T.

MISCELLANEOUS TRANSFORMERS

7—25 KVA 450-117 v. 1/60 cy. West. Dry Type
1—7½ KVA 230/460-115/230 v. 1/60 cy. Moloney Dry Type
8—6.6 amp Const. Current 2 KW 240 v. Generaal Electric Type R0.
3—Ignition Transformers 115 v. 60 cy. 200 VA France Co.
8—Novulux Controllers—G.E. CR-7841-GB2 230/2300 v. 120 v. 60 cy. Line amps 100/50.

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A RENTAL COMPRESSOR FOR EVERY JOB

55 CFM Lindsay (GAS) Portable
60 CFM Worth—CPT—Portable
80 CFM 6 x 7 Worthington HB, 15 HP Elec.
105 CFM Worthington—IR—CPT Portable
107 CFM 7—7 x 7 Ingersoll FS-I STEAM
122 CFM 7 x 7 Ingersoll ES-I 20 HP
142 CFM Ingersoll Semi-Portable 25 HP
160 CFM IR-Worth Portable
165 CFM Smith 1105R Semi-Portable, 25 HP
167 CFM 10 x 5 Ingersoll Vacuum Pump—7½ HP
195 CFM 8—8 x 9 Worthington HS STEAM
210 CFM Worthington (GAS or DIESEL) Port
211 CFM 9 x 9 Chicago T-B 30 HP Elec.
279 CFM 11—10 x 11 Worthington HS Steam
294 CFM 10 x 11 Worthington HB 50 HP Elec.
315 CFM Worthington (GAS or DIESEL) Port
434 CFM 14 x 7 Ingersoll Vacuum Pump—15 HP
492 CFM 13½/9 x 10 Chicago O-CB Duplex 75 HP Elec.
600 CFM Worthington (DIESEL) Portable
628 CFM 14 x 13 Ingersoll ES-I, 100 HP
720 CFM 18 x 7 Worthington HEV Vacuum Pump 25 HP
868 CFM 17/10 x 12 Chicago O-CB Duplex 150 HP Elec.
1184 CFM 22 x 9 Chicago T-VB Vacuum Pump 40 HP
1633 CFM 24 x 11 Chicago T-VB Vacuum Pump 60 HP

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FOR SALE

(4) 300 KW G.M. 8-268A DIESEL GEN.
G.M. diesel generator sets—120/240 volts DC—1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

(2) 60 KW CUMMINS DIESEL GEN.
120/240 volts DC—250 amps.—Model H engine—6 cylinder—heat exchanger cooled.

(2) 100 KW GM 3-268A 440/60/3 AC generator sets.

(1) 100 KW LORIMER 440/60/3 AC generator set.

(1) 100 KW FAIRBANKS-MORSE opposed 440/60/3 AC generator set.

75 KW WAUKESHA DIESEL GEN.
Heavy duty—totally enclosed—with built-in switchgear. 75 KW — 230 volts DC. 6 cyl. Waukesha diesel, 160 HP, 1200 RPM. Radiator cooled.

(6) 300 KW TURBO GENERATOR SETS
120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stabilized shunt generator. With switchgear. Built 1945. Excellent condition.

(1) SUPERIOR HEAVY DUTY DIESEL
510 HP at 360 RPM—5 cylinder—14½x8—type ZDSB—non-reversing—vertical—4 cycle—cold starting—mechanical injection. Engine totally enclosed. For heavy duty pumping, dredge service, power generation, textile & saw mills, etc. Excellent condition. Immediate delivery.

ELECTRIC WINCHES
50 HP—230 volts DC—built in controls—5 ton and 10 ton.

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BALTIMORE 2, MD.
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✓ Complete Stock A.C. & D.C. Motors and Generators
✓ New and "Certified Rebuilt"—UP to 1000 H. P.

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse syn cond		4000/2300	900
625	Gen. Elec.	ATB	2300	450
600	Gen. Elec.	ATB	480	900
625	El. Machy.	Late	240/480	1200
485	Allis Ch.	1 brg.	480	400
350	El. Machy.	1 phase	480	1200
312	Gen. Elec.	ATB	240/480	600
275	G. E. 25 cycle	ATI	480	750
225	El. Machy.		480	720
225	Gen. Elec.	ATI	240/480	900
150	Allis Ch.		240/480	1200
150	Gen. Elec	ATB	2300	900
150	Whse.		2300/480	600
125	El. Machy.	Syn.	240/480	1800
125	Gen. Elec. (2)	ATB	240/480	900
112	Gen. Elec.	ATB	240/480	900
75	Gen. Elec.	ATI	240/480	1200
75	El. Machy.		2300	900
56	G. E.	ATB	240/480	1200
25	Whse. b.b.	1 phase	120/240	900

LOW VOLTAGE M-G SETS—2
Whse. 3636 amp. 20/55 V DC gen. w/synch. motor 220/440 V. 720 RPM and exciters.

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	Al. Ch.	MECW	125/250	1200
250	Allis. Ch. b.b.	EW	350	1200
250	Gen. Elec.	MPC	250	600
200	Gen. Elec.	RC	250	1150
150	Gen. Elec. b.b.	CDM	250	1500
105	Century b.b.	1500 amp.	70	1200
100	Allis. Ch.	E	125	1200
100	Allis Ch. (2)	E182	250	900
75	G. E. b.b. (2)	CDM135	125	750
75	Whse.	SK	250	900
75	Cont. b.b.	D109X	125	1200
75	Columbia b.b.		120/240	1450
60	Allis. Ch.	E147	250	900
60	Whse. b.b. (2)	SK121	300	1200
60	Reliance	T	250	1150
50	Allis. Ch.	EW	125/250	1200
40	Gen. Elec.	CD103	250	1500
40	F. Morse b.b.	DH	125	1800
40	Gen. Elec.	RC	600	1750
25	Whse.	SK93	125	1750
25	C. W. b.b. (2)	CCD	250	1200
20	Gen. Elec.	RC	125	1150
15	Star b.b. (10)	SQ	250	1500

100—VERTICAL MOTORS—100
Most sizes and speeds up to 150 H.P. Send for our complete listing.
LOW PRICES—SAVE UP TO 80%

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
300	Allis Ch. b.b.	EW	350	1000
250	Gen. Elec.	LDR	250	450/850
200	G. E. (2)	RC59	230	850
150	Whse.	SK-201	230	300/900
100	Allis. Ch.	E182	230	600/1200
75	F. Morse b.b.	DH140	115	1600
75	Whse.	SK170	230	635
60/75	Gen. Elec	C	230	500/1200
50	Reliance	310T	230	850
50	Whse.	SK150	230	750
50	Reliance b.b.	651T	230	750
50	Gen. Elec.	CD123	230	550/1200
50	Cr.Wh. b.b.	FH	230	1750
50	Whse.	SK183	230	300/900
40	Whse.	SK143	230	600/1500
40	Reliance	651T	230	350/1000
40	Allis. Ch.	E-121	230	1750
40	Gen. Elec. (2)	CD103	230	1150
40	Gen. Elec.	RC32	550	1200
40	F. Morse b.b.	DH 120	115	1750
30	Imperial b.b.	D69	230	400/1600
30	Star b.b. (3)	SB	230	1750
25	Whse.	SK150	230	300/1200
25	Gen. Elec.	CD105	230	575/1720
20	Century b.b.	DN330	230	3500
20	G. E. series	CO-1826	230	875
20	Whse b.b. (2)	SK97	550	900

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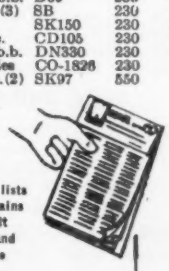

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	G. E.	Slipring	2300	400
750	Whse.	Synch.	2200/4000	900
700	G. E.	Synch.	2200	514
600	E. M.	Synch.	480	1200
600	G. E. (2)	Synch.	2200/440	360
550	G. E.	Sq. Cage	2200	3600
500	G. E.	Slipring	2200/440	450
500	G. E.	Sq. Cage	6600/4000	1800
500	G. E.	Synch.	440	900
450	Allis. Ch.	Synch.	480	400
400	Whse.	Sq. Cage	2200	514
400	G. E.	Synch.	440	450
400	Allis. Ch.	Sq. Cage	2200/440	1200
350	Whse. (2)	Slipring	2300	450
300	G. E.	Slipring	2200/440	720
300	El. Mach.	Synch.	220/440	360
300	Al. Ch.	Sq. Cage	2200/440	720
300	Whse.	Synch.	2200/440	600
300	Al. Ch.	Slipring	2300	514
300	G. E.	Slipring	440	360
250	G. E.	Synch.	220/440	720
250	Whse. (2)	Sq. Cage	2200/440	1200
250	L. A. (2)	Sq. Cage	2200	1800
225	G. E.	Synch.	220/440	900
200	Whse. Ex. Pf.	Sq. Cage	2200/440	1200
200	Allis. Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	2200/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	G. E.	Slipring	220/440	600
200	E. M.	Synch.	220/440	1200
200	G. E.	Slipring	220/440	360
200	Whse.	Sq. Cage	220/440	1800
200	G. E.	Sq. Cage	220/440	1200
200	E. M.	Synch.	220/440	514
175	Whse.	Synch.	220/440	360
150	Whse.	Sq. Cage	220/440	900
150	G. E. TEFC	Sq. Cage	2200	3600
150	Allis Ch.	Slipring	2200/440	720
150	G. E.	Synch.	220/440	450
150	Allis Ch.	Slipring	2200/440	720
150	G. E. (2)	Sq. Cage	2200/440	720
150	G. E.	Slipring	220/440	450
150	Allis Ch.	Sq. Cage	2200/440	1200
150	Rel. b.b.	Sq. Cage	220/440	1800
150	Allis Ch.	Sq. Cage	440	450
125	Rel. TEFC	Sq. Cage	220/440	1800
125	G. E. (2)	Slipring	220/440	600
125	G. E.	Slipring	220/440	450
125	E. M. (2)	Synch.	220/440	1800
125	Allis Ch.	Slipring	220/440	900
100	G. E. TEFC	Sq. Cage	220/440	1200
100	G. E.	Slipring	220/440	900
100	Whse.	Sq. Cage	220/440	900

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	G. E.*	440 AC	250 DC
300	Allis. Ch.	2200/440 AC	125/250 DC
300	Whse.*	2300 AC	600 DC
250	Allis. Ch.	2200/440 AC	350 DC
200	Whse.* (2)	220/440 AC	55 DC
200	G. E.*	220/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
175	G. E.	2200/440 AC	250 DC
105	Century b.b.	220/440 AC	70 DC
100	Al. Ch.	220/440 AC	125 DC
100	Deloo b.b.	220/440 AC	125/250 DC
80	Star* b.b.	220/440 AC	240 DC
75	Cont. b.b.	220/440 AC	125 DC
60	Gen. Elec.*	220/440 AC	60 DC
60	Whse. (2)	220/440 AC	300 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Allis Ch.	220/440 AC	125/250 DC
50	Cr.Wh.b.b.(2)	220/440 AC	240 DC
40	G. E. (2)	220/440 AC	250 DC
40	Gen. Elec.	220/440 AC	600 DC
30	Whse.	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC
25	Gen. Elec.	220/440 AC	250 DC
20	Star b.b.	220/440 AC	120 DC
16	Gen. Elec.	220/440 AC	125 DC
15	El. Prod.	220/440 AC	40 DC

*Synch. motor.

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GUARANTEED REBUILT POWER EQUIPMENT

M. G. SETS

K.W.	Make	A.C.	D.C.
1000 (3u)	Westgh.	11000	137/275
500	Westgh.	2300	137/275
500	Westgh.	2300	275
450 (3u)	G.E.	2300	125/250
400	A.C.	2300	120/240
300	G.E.	2300	250
200	G.E	2300	250
200	Westgh.	4160	250
200	G.E.	440	550
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	G.E.	4000	250
150	A.C.	2300	275
150	G.E	440	275
100	Westgh.	440	125
100	Elec. Mch.	440	125
100	Ridgeway	2200	275
100	G.E.	240	230
100	G.E.	440	125
75	G.E.	440	125
90	G.E.	440	60
60	Westgh.	2300	125
60	A.C.	2300	125
50	G.E.	240	250
50	Reliance	440	250
50	Westgh	240	125
40	G.E.	440	125
40	G.E.	440	250
35	Westgh.	2300	150
30	G.E.	440	250
30	Westgh.	2200	125

SAVE 50 to 80% OVER NEW and get GUARANTEED PERFORMANCE

CHICAGO ELECTRIC
Carries Complete Stock of

- A.C. MOTORS
- D.C. MOTORS
- M.G. SETS
- GENERATORS
- TRANSFORMERS
- CONTROLS
- COMPRESSORS
- HOISTS • PUMPS
- SWITCHBOARDS

SLIP RING MOTORS

2 Phase, 60 cycle, 220 or 440 Volts (*2300 Volts or higher)

HP	Make	Type	Speed
2000	*G.E.	MT 12	600
1500	*G.E.	MT 30	240
1250	*Westgh.	CW	600
1000	*Westgh.	CW	250
800	Allis-Chal	ANY	600
700	*Al-Ch	ANY	720
600	*G.E.	MT 422	600
500	*Al-Ch	ANY	600
500	Westgh.	CW	350
400	Al-Ch	3-Brg	450
400	*G.E.	MT 412	450
300	*G.E.	IE-15A	1800
300	*G.E.	MT-410	450
250	Westgh.	HF-15H	600
200	*Westgh.	CW	1200
200	G.E.	IM	600

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 Volts (*2300 Volts or better)

HP	Make	Type	Speed
1750	*G.E.	K	3600
1500	*Westgh.	CS	1200
800	*G.E.	K	1800
800	*Westgh.	CS-1485	1800
700	*Westgh.	CS	1200
600	G.E.	FT-559	3600

D.C. MOTORS

Mill Type—Pedestal Bearing Reversing

HP	Make	Volts	Speed
1500	West.	525	600
1200	West.	525	600
1000	West.	450	600

230 Volt

HP	Make	Type	Speed
250	Westg.	SK-201	850
250	Westg.	SK-220	450/800
250	G.E.	MPC-4	700
200	Cr. Wh.	CM	500
175	G. E.	ELC	750
100	G. E.	MPC	400/800
100	G. E.	RC-34	2500
100	G. E.	RC-19	575
100	G. E.	MPC	400
50	G. E.	RC-31B	1700
50	G. E.	RC-35	700
50	G. E.	DCC-204	650
40	A. C.	E-140	750
30	Cr. Wh.	CCM-504	450
25	Westg.	SK-1006	1100
25	G.E.	RC-32	800
25	A. C.	E-130	775
25	Westg.	SK-133	575
20	Star	SB-10	1750

If you don't find what you need. Wire, write or phone for complete stock list.

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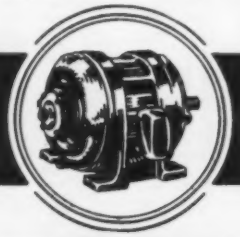

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1320 WEST CERMAK ROAD, CHICAGO 8, ILL.

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BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.
Custom-built transformers and coils manufactured to your specifications.
Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned.

Ask for our price schedule

THE ELECTRIC SERVICE CO., INC.
5331 Hetzel St. Cincinnati 27, Ohio
40 Years' Dependable Service

6 LARGE PRODUCTION WELDERS

MOTORS: 160 HP—440 volts—3 phase—60 cycle—1160 rpm—185 amps.—squirrel cage. Manufactured by Century. WELDING GENERATORS: 105 KW—Frame 97—70 volts—1500 amps.—compound wound—Century. Excellent condition. BARGAIN PRICE! SUITABLE FOR TANK BUILDERS—SHIPYARDS—RAILROADS, etc.

THE BOSTON METALS CO.
313 E. Baltimore Street
Baltimore 2, Md.
Curtis 7-5050

MOTORS · MG SETS

Qty.	HP	Make	Voltage	Speed
12	2000	West.	525/600	600 RPM
28	1500	West.	525/600	600 RPM
32	1500	Al. Ch.	525/600	675 RPM
4	1200	Al. Ch.	525/600	650 RPM
2	600	Elliott	230	300/195 RPM
3	800	West.	525/600/600/900	RPM
1	650	Cr. Wh.	230	475/720 RPM
1	500	West.	230	250/500 RPM
1	400	G.E.	230	180/360 RPM
7	400	Elliott (new)	230	400/800 RPM
5	400	West. (new)	230	375/750 RPM
2	250	Cr. Wh.	230	400/800 RPM
1	200	Cr. Wh.	230	500/750 RPM
1	200	Cr. Wh.	230	375/750 RPM

All motors designed for mill reversing service.

Smaller sizes also in stock.

Motor Generator Sets in Stock
100—2000 KW Capacity

All of above is modern late type equipment remanufactured & tested by our engineers.

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All guaranteed for one year

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Plants: SAUSALITO (S.F.) CAL., JERSEY CITY, N.J.

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Used—In Excellent Condition

1—Westinghouse generator: 625 KVA, 500 KW, .8PF, 3600 RPM, 480 Volt, 3 phase, 60 cycle, 750 amp. Serial #4265547.

1—Westinghouse generator: 375 KVA, 300 KW, .8PF, 480 Volt, 3 phase, 60 cycle, 452 amp., 1200 RPM, SO-33F 326, #1S33F326.
Turbine, exciter, motor, switchboard, condenser. Complete with accessories.

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1—Worthington: centrifugal type, 25-90 HHP, 1000 GPM. Moore steam turbine, 88 HP, 2500 RPM. Complete with accessories.

Available immediately

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Miners Bank Bldg. Wilkes-Barre, Pa.
VAlley 3-7151

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We can save you 40% to 50% of your present net cost on the following 220/440 volt, 60 cycle, 3 phase, 1800 rpm. motors. They are all NEW in ORIGINAL FACTORY CRATES:

Qu.	H.P.	Make	Type	Description
3	25	Ideal	A-365	S. B. open
3	40	L. A.	OGX-404	S. B. drip proof
3	50	Century	SC-405	S. B. drip proof
2	50	Ideal	A-405	S. B. open
4	60	Ideal	AH-444	S. B. open
2	60	L. A.	OGA-444	S. B. drip proof

POWER EQUIPMENT COMPANY
8 CAIRN ST., ROCHESTER 2, N. Y.
P. O. BOX 534 — Tel: Genesee 5629

SPECIAL OFFER TO: **CHEMICALS & REFINERIES**

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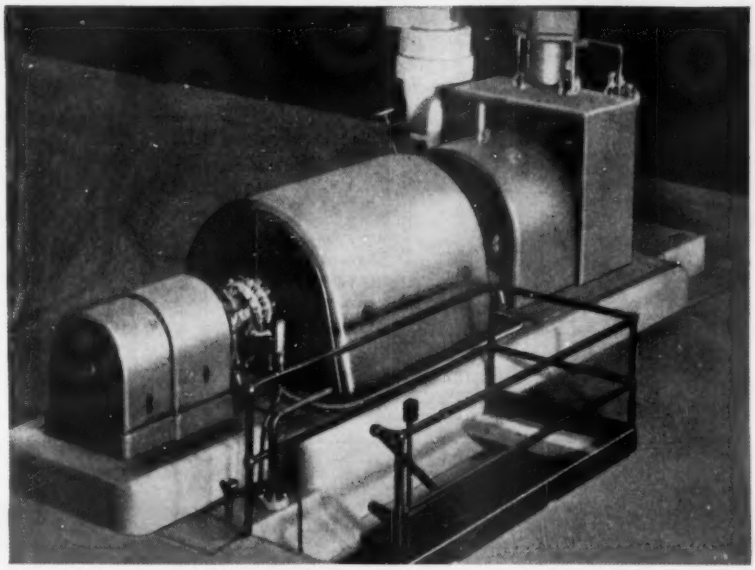

A REBUILT G.E. TURBINE SET

TURBINE SETS: 500-KW., to 2500-KW., UNITS, Non-condensing, Now in Stock: Immediate Deliveries. 2250 KVA., G.E., 450#, 750°F. COND., Like New.

ALSO 2 B & W BOILERS, New, Never Erected, 150,000 lbs. Steam pr. hr. 350# psig., 750° F. TT., 2-Drums. Many Other High Grade Boilers.

IN STOCK ALSO: CONDENSING TURBINE SETS 300-KW. to 12,000-KW., ALL HIGH GRADE UNITS: ALSO FULL LINE OF DIESEL POWER

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18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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408 DONOVAN BLDG.
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BOILERS
10 TO 5000 HP — 10 TO 900 PSI
EXISTING
DIESEL ENGINES — STEAM TURBINE
GENERATORS
5 TO 20,000 KW
STRICKLER ENGINEERING CORPORATION
5220 Pennington Ave., Baltimore 26, Md.
Curtis 7-2772

M-G SETS! MOTORS!

1—500 KW, 240 V. D.C., Whse. M-G Set, 900 RPM, Syn. Drive, 3/60/2200, Ser. 4979926 with magnetic reduced voltage starter.

1—200 KW, 125 V D.C., Type PED, Ser. 576881, E-M Set, 900 RPM, Syn. drive, 3/60/2300 (or 4160).

TURBO-GENERATOR

1—750 KW, Elliott AC Generator, Frame 3232, 3600 RPM, 3/60/480. Elliott Turbine, inlet 200# ga., 112 deg. F superheat. 28" hg. vac. exhaust. Complete with accessories.

SYNCHRONOUS CONDENSER

1—1000 KVA, Allis-Chalmers, 3 phase, 60 cycle, 2300 volts, 600 RPM.

SQUIRREL CAGE MOTORS

Amt.	HP.	Speed	Make	Type	Frame
1	250	1200	Elliott—BB	Splash	2810
3	250	600	G. E.	KT568	
1	150	1800	Whse.	CS (2200V.)	8715
1	150	1800	A-C		
1	150	900	G. E.	I-K (220V.)	15
1	100	1800	Whse.	CS	663C
1	100	1200	L.A. XP-1D	EX	108
1	100	900	G. E.	MT356	Slpr.
1	100	900	A-C	2300V.	

NEW MOTOR STARTERS

3—Size, A-B, XP-2G Label Bul. 709

1—Size 3, Whse. Combination, circuit breaker, Nema 1, 3/60/440

21—Size 2, G.E. Combination fusible, 60 and 100 amp, 3/60/220, CR7008A42C

88—Size 1 Whse. life line, 3/60/220

7—60 thru 200 HP EC&M, 3/60/2300 Size 10 Magnetic Compensators

GEARMOTORS

1—20 HP, 400 RPM, Westinghouse ID-XP

2—10 HP, 55 RPM, Whse. Fr. 324, parallel shaft output

1—7½ HP, 11 RPM, Whse. Fr. 284Y, TEFC

18—Cleveland right angle worm gear reducers, rated 5 HP-1150 RPM, 7.5 HP-1750 RPM, 6-1 ratio, Series 215, Size 50 RT, Class 1

4—Ratio 10-1, Series 25F—ditto

NEW INGERSOLL-RAND MOTOR PUMPS

Amt.	GPM	HD.	Type	Motor Encl.
2	140	90	2—ORVL-7½	TEFC
2	134	90	2—ORVH-5	XP-1-D
1	1500	35	5—KVL-25	XP-1-D
1	1½ x 1½		AC, SSL	XP-1-D

OISC-TRANSFORMERS—Single Phase

Amt.	KVA.	Make	Type	Volts
9	37½	G.E., Moloney, Whse.		2400-240/480
2	50	Wagner	HEX	4000-1328/2300Y
3	75	Whse.	S	2400/4160-480/240
3	150	Moloney	HE	4000-230/460

PARTIAL LISTINGS—10,000 OTHER MOTORS IN STOCK—SLIPRING—SYNCHRONOUS. NEW MOTORS AT LONG DISCOUNTS.

BENSON-WILIMZIG, INC.

1708 North 8th St. Phone—Garfield 1-4290 St. Louis 6, Missouri

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
600	440	Whse.	1800
600	2200	Whse.	450
500	2200/4000	G. E.	900
450	440	Whse.	514
450	440	Whse.	720
400	440	G. E.	900
300	4000/2300	Whse. (new)	600
300	2200/440	G. E.	720
300	440	G. E. (hoist)	600
300	2200	G. E.	360
300	440	Whse.	3600
250	440/220	Whse.	600
250	550/440	G. E.	1200
250	440	G. E.	600
200	440/220	Whse.	514
200	440	G. E.	450
150 (2)	440/220	G. E.	720
150	2200/440	G. E.	600
150	550/220	G. E.	720
145	4000/2300	G. E.	1800
135	440/220	G. E. (hoist)	600
125	440/220	G. E.	900
125	550/440	G. E.	1200
125	2200	G. E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G. E.	ATI	720
375	440/220	Whse.	G	900
350	440/220	El. Mchy.	Syn.	1200
300	2300/400	G. E.	TS	720
300	2200/440	G. E.	TS	1200
250	2200/440	G. E.	TS	720
250	440/220	G. E.	ATI	1200
250	2300	G. E.	TS	3600
250	440/220	Whse.	HR	277
250	2300/440	G. E.	TS	1200
250	440/220	G. E.	ATI	600
200	4150/2300	Whse.	G	1800
125	440/220	Whse.	HR	400
110	440/220	G. E.	TS	257

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G. E.	FT	3600
500	2200	Whse.	CS	514
500	2200/4000	Elliot	SC	1800
500	2200	G. E.		450
400	2200	G. E.		360
400	2200/400	Whse.	CS	720
300	2200	L. Allis	FS	1800
250	2300/440	G. E.	IK	720
225 (2)	2200/440	G. E.	KT	1200
200	2200/440	G. E.	K	1200
200	440	G. E.	IK	720
200	440/220	G. E.	KT	1800
200	2200/440	G. E.	JK	600
200	2200	G. E.	KT	1800
150	440/220	Whse.	CS	900
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440	Multi sp.	KT	1800/600
150	440/220	G. E.	IK	450
150	440/220	G. E.	KT	720
150	440/2200	G. E.	IK	514
150	2200/440	G. E.	KT	600
125	440/220	G. E.	KT (vert.)	1200
100	2200/440	G. E.	K	1200
100	220/440	G. E.	K-TEFC	720
60 (2)	2200	Whse.	CS X-pf.	1800
50 (2)	410/220	Whse.	CS-TEFC	1800
50	220	Al. Chal.	X-prt.	600/1200

A. C. GENERATORS

1—320 kva. 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 480/220 V., G. E.
1—250—kva. 720 rpm. 2300/440 V., G. E.
1—225 kva. 600 rpm. 220/440 V., G. E.
1—200 kva. 720 rpm. 2200/440 V., G. E. (Ball brg.)
1—187 kva. 1200 rpm. 2300/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G.E., Sol. oper., draw-out.

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
250	230 (2 new)	Cr. Wh.	CMC	1800
225	230	Whse.	SK	2870
200	230	G. E.	CD	750
150	230	Whse.	SK	1750
100	230	Whse.	SK	400/1200
100	230	Cr. Wh.	CMC	625
90	230	G. E.	CD	1750
80	230	G. E.	RC	600
50	230	Rel.	T	400/1200

MOTOR GENERATOR SETS

KW	Make	Input V., Motor AC	Type	Output V., DC
250	Whse.	440/220	Syn.	250
250	Whse.	2200	Syn.	250
175	G. E.	220/440	Syn.	230
125	G. E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	sq. ca.	240/120
100	Whse.	440/220	sq. ca.	125
75	G. E.	2200/440	Syn.	125
65	G. E.	2200/440	sq. ca.	250
65	G. E.	2200/440	sq. ca.	125
45	G. E.	440/220	sq. ca.	250

TRANSFORMERS 60 Cy.

3—667 kva. Al. Chal., 22000/11000—2300 V.
1—600 kva. Standard, 13.800-2300 V., 3 ph.
2—500 kva, G. E. 22000/11000—2300 V.
3—500 kva, Whse., 66000—2300 V.
3—333 kva. G. E., 12000—2300 V.
3—200 kva, G. E. 2300—575 V.
3—200 kva, G. E., 11000—2300 V.
3—200 kva. G. E., 4150—480/240 V.
3—150 kva. G. E., 33000—2300/4600 V.
3—150 kva. Al. Chal., 2400—240/480 V.
3—150 kva. Al. Chal., 2400—240/120 V.
6—100 kva, Whse., 2400—120/240 V.
5—100 kva, G. E., 4150—120/240 V.
2—100 kva. Whse., 2400—120/55 V.
3— 75 kva, Whse., 2400—240/480 V.
3— 75 kva, Moloney, 4150—240 V.
3— 50 kva. Whse., 440—220/110V
6—50 kva, G. E., 2400—120/240V

STEPHEN HALL & CO.

HARRY J. RICE PRES.

458 SEVENTH ST. HOBOKEN, N. J.

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Used Steam Plant Equipment

2—B&W Sterling W.T. Boilers 501 H.P. with Westinghouse Underfeed stokers, hydraulic ash dump, forced draft fans, boiler feed pumps and feed water heater.

2—De Laval Steam Turbines 1600 H.P. with reducing gear, condensers, Rado-Jet Air pumps and circulating water pumps.

2—De Laval Steam Turbo Generator Units, non-condensing with 50 Kw 250 volt DC generators.

Above equipment to be sold on sealed bids opening April 22, 1954.

For further information and bid forms, apply to

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Supt., Bureau of Water,
Knoxville Utilities Board
626 S. Gay St., Knoxville 1, Tenn.
Telephone No. 3-1161

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TRANSMISSION LINE MATERIALS

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APPARATUS EXCHANGE
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TRANSFORMERS COMPLETE WITH INSULATORS AND HANGARS LIKE NEW

12 G E Spirakore Transformers, No. 8000352 and around, KVA 5, Single Phase, 60 Cycle Voltage Rating 7200/12470Y—120/240

3 Transformers, KVA 10, Single Phase, Westinghouse, 60 Cycle, VR 2400/4160Y—120/240, Line Material, 60 Cycle, VR 7200/12470Y—120/240, Wagner, 50 Cycle, VR 2400/4800—120/240.

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YORKVILLE, NEW YORK
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WORLD'S LARGEST INVENTORY

NEW AND GUARANTEED REBUILT EQUIPMENT

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ELECTRIC EQUIPMENT CO.
L. D. (Long Distance) 65
ROCHESTER 1, NEW YORK
Explosion Proof Motor Headquarters

CONDENSER

1—used Westinghouse Powerhouse Surface Condenser, three pass, 843 square feet, with hot well. No pumps.

PUMPS

1—used McGowan Steam Pump, duplex, 5¼ x 3½ x 5, with bedplate and mechanical lubricator.

1—used National Steam Pump, duplex, 6x4x6. No bedplate or lubricator.

BURFORD, HALL & SMITH
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ATLANTA 3, GA.

For Sale — Bargain
2—1800-HP., O.P. TYPE DIESELS.
Like New. Spare Parts. Lloyd's Inspection Report.

Immediate Delivery
CHARLES WEAVER
4145 Penobscot Bldg., Detroit 26, Mich.
Woodward 1-1340

1—2000 KVA — 3-60-33000-4160Y Westinghouse type CPS Westinghouse self-contained substation.
1—450 KVA—3-60-13200-115/230 V. GE substation.
4—100 KVA—3-60-2400-208/120 V pyranol GE transformers with 225 A3 pole airbreaker mounted on case.
700 & 450 HP—180 rpm—4160 V UNUSED syn. motors.

H. BLAINE JOHNSON & ASSOCIATES
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PRESSURE & STORAGE TANKS

N.Y., Conn., Ill., Mo., Georgia

2—35,000 GAL. 60# W.P. 11'x54'
5—17,300 GAL. 85# W.P. 8'x45'
42,000, 120,000, 240,000 GAL. STORAGE
8—10,000 GAL. RAILROAD CAR TANKS

LESTAN CORP., ROSEMONT, PENNA.

If there is anything you want

or something you don't want that readers can supply—or use—advertise it in the

Searchlight Section

O'Brien Offers—

MOTOR GENERATOR SETS

2—1500 KW Westinghouse 275 V D.C. 514 rpm with 3/60/13,200 V. Synch. Mtr. drive.
1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
Smaller Sizes and Types—Advise Requirements

DIESEL GENERATOR SETS

900 KVA GM 12-567 Diesel 3/60/2300
750 KVA GM 12-567, 3/60/2300
375 KVA GM 8-268 Diesel 3/60/440
300 KW GM 8-268 Diesel 125/250 V. D.C.
187 KVA GM Twin Diesel 3/60/220 New
125 KVA Waukesha Diesel 3/60/220-440
100 KW Buda Diesel 250 V. D.C.
100 KVA Murphy Diesel 3/60/220-440
65 KVA Buffalo Gas 3/60/220
56 KVA Climax Gas 3/60/220
45 KVA Chrysler Diesel 3/60/220
30 KVA LeRoi Gas 3/60/220
25 KVA LeRoi Gas 1/60/120/240
20 KW Hercules Gas 110 volt D.C.
18.75 KVA Hercules Diesel 1/60/120/240

BOILERS

1—300 HP Keeler CP 300 lb. Oil
1—250 HP Ames Package type (1948) 150 psi oil fired
1—250 HP B & W 250 lb. 1948
2—200 HP Springfield Sec. Hdr. 400 psi.
1—100 HP Clayton Pkg type 160 psi oil fired
1— 25 HP Dowtherm Vaporizer

ELECTRIC MOTORS

Qu.	HP	Make	Type	Volts	Speed
1	1500	Al. Ch.	sl. rg.	2300	514
1	1000	G.E.	K	2300	1800
1	1000	West.	CW	2300	450
1	700	West.	CS	2300	1800
1	500	Al. Ch.	Syn.	2300	212
1	500	AC	ARX	2300	1800
1	500	West.	CS	6600/2300	514
1	450	A.C.	ANY	2300	600
1	400	West.	CW	440	514
1	400	G.E.	Syn.	2300	450
3	3500	G.E.	IM	2300	120
1	350	G.E.	MT18	2300	400
2	200	G.E.	KT559	2200	1200
1	200	West.	CW	440	1800
1	200	G.E.	IM	440	600
1	125	West.	Syn. 3 brg.	550	600
2	100	G.E.	KT352	220/440	1200
1	50	West.	CS	440	3600
1	50	West.	CS	440	1200

TURBO GENERATORS

Philadelphia Stock

1—2500 KVA West. Cond. New 1936. 3/60/2400—200 psi Surf. Cond.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—50 KVA 1200 rpm Century generator (New 1949) Dean Hill Non-condensing turbine
1—75 KW G.E. Non-Cond. D.C. 125 volt.

AIR COMPRESSORS

1—1600 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—1000 CFM Chicago OCE Syn. Mtr. Dr. 175 HP 3/60/2300.
1—978 CFM Sullivan 13x13x8, 45 psi.
1—670 CFM Chicago OCE Syn Mtr Dr. 3/60/2300
1—396 CFM Sullivan WL60 125 psi Direct Drive 75 HP 3/60/440
1—215 CFM Penna 3A, 70 psi—V-Belt.
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7½x6x4, 100 psi
1—173 CFM Chicago NSB 100 psi

OISC TRANSFORMERS

Qu.	KVA	Make	Pri. V.	Sec. V.	Phase
3	2000	G.E.	13200	230/460	1
3	1000	GE	13200	2300	1
1	1100	West.	4160	440	3
3	667	Al. Ch.	33000	2300	1
3	500	West. Dry	33000	2300	1
3	500	West.	22000	460	1
1	500	Gregory	4160	440	3
3	500	GE	13200	2300	1
3	400	GE	2400	480	1
3	333	West. Dry	2400	480	1
3	333	Pitts.	33000	2300	1
3	333	G.E.	13800	240/480	1
2	250	West. Dry	13800	230	1
3	150	West.	2300	230/115	1
3	150	Dry	2300/4160	230/460	1
3	100	Dry	2300/4160	230/460	1

1—New O'Brien "Red-Line" 750 KVA OISC Transformer 13,200/13,800 v. pri., 480 v., sec., 3 ph.
3—333 KVA New O'Brien Red Line O.I.S.C. Transformers 4160 V primary 480 V secondary ea. single ph. 60 cyc.

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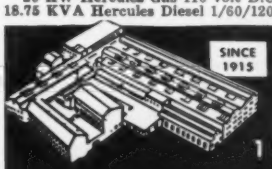

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3040 CFM Sullivan WN4—2300 V.
3074 CFM Chgo. Pneu. OCE—2300 V.
2—2200 CFM Chgo. Pneu. OCE—440 & 2200 V.
2—1722 CFM Chgo. Pneu. OCE—440 & 2200 V.
1750 CFM Worthington—440 V.

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ULster 5-3588

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DIRECT CURRENT MOTORS
230-V. D.C.

Qu.	HP	Make	Type	RPM
6*	3000	Whse.	Mill	600
14*	1500	Whse.	Mill	600
10*	800	Whse.	Mill	600
8	700	Whse.	Mill	285/700
1	350	G. E.	CD-169	1150
1	250	G. E.	MPC	325/975
1	200/250	G. E.	MPC	300/900
1	200/250	El. Dy.	Size 22	400/1200
1	200	Whse.	Mill	300/1200
1	180	G. E.	MPC	400
1	160/90	G. E.	MPC	625/1125
1*	125	Whse.	SK-190	600
2	125	Whse.	SK-184	575/850
6	100	El. Dy.	30-S	450/1100
6	75	C.W.	53 H	860
1	50	Whse.	SK	250/1000
1	40	Whse.	SK-140	500/1700
1	35	G. E.	CD-125	400/1200
1	35	G. E.	CD-147	300/1200

*—525 and 600 V. D.C.

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
1 (3U)	2400	Whse.	720	600	4800/2400
2	1750	G. E.	450	250	4600/2300
2	1200	Whse.	720	600	2300
2	1000	G. E.	900	600	13200/6600
2	500	C. W.	720	575	2300/440
1	400	C. W.	1200	125/250	2300/440
1	400	C. W.	720	250	2300/440
1	300	Whse.	900	250	2300
1	150	G. E.	720	250	2300/440
1	100	Ridgway	1200	275	4000/2300
1	100	C. W.	1200	125	440/220
1	100	Whse.	900	250	2300

SLIP RING MOTORS
Constant Duty 3 phase 60 cycle

Qu.	HP	Make	Type	Volts	RPM
1**	1800	G. E.	MT-498	2300	357
1**	1200	G. E.	MT-26	2200	277
1	700	G. E.	I-M	2300	400
1*	600	G. E.	MT-20	2300	360
1**	500	Al. Ch.	ANY	2200	514
2	500	G. E.	I-16-M	2300	450
2	400	G. E.	MT-412	2200	450
1	300	G. E.	I-M	2200	600
1	250	Whse.	CW-937	440	1200
1	250	G. E.	MT-414	2200	300
1	250	Al. Ch.	ARY	440	720
2	100	G. E.	I-15-M	2300	514

**Pedestal bearing design

SQUIRREL CAGE MOTORS
3 phase 60 cycle

Qu.	HP	Make	Type	Volts	RPM
1	400	G. E.	IK	2300	514
1	300	Whse.	CS 890	2300	1750
1	200	Al. Ch.	A.R.	440/220	580
1	200	Whse.	CS 873 C	2200	1160
2	125	Al. Ch.	A.R.	2300	1750
1	125	Al. Ch.	A.R.	2300	440
1	100	G. E.	KT 562	440/220	570
1	100	Whse.	CS 938	2200	495

SYNCHRONOUS MOTORS
3 phase 60 cycle

Qu.	HP	Make	PF	Volts	RPM
1	3000	Whse.	80	4800/2400	720
2	2100	G. E.	100	2300	360
2	2000	G. E.	80	2300	720
2	1750	G. E.	100	2200	3600
1	750	G. E.	80	2300	450
1	710	G. E.	80	2300/440	720
1	250	G. E.	100	2300	514
1	250	G. E.	80	2300	600
2	200	Whse.	80	440/220	1200
1	187	G. E.	80	440/220	720
1	150	G. E.	100	2200	900
1	150	G. E.	80	440/220	450
2	135	G. E.	80	4000/2200	1200
1	135	G. E.	80	2200	900
2	100	Whse.	80	440	1800
2	100	G. E.	80	440/220	600

TRANSFORMERS
60 Cycle

Qu.	KVA	Make	Phase	Voltage
2	750	Pitts.	1	23,000–2300
3	667	Wagner	1	22,000/11,000–2300/4000
3	500	G. E.	1	22,000/11,000–2300/4000
3	150	Al. Ch.	1	4160/7200–240/480
3	100	G. E.	1	33,000–2300
3	25	G. E.	1	2400–120/240
42	3	Al. Ch.	1	2400–120/240

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125 VOLT DC GENERATORS

KW	Make	Speed
200	West.	900
150	Westg.	1200
150	Westg. (3)	900
100	Cr. Wh.	1200
100	E.M.	1200
100	G. E. (2)	900
100	Westg.	1200
100	Westg. (2)	900
75	G. E. (2)	1200
50	Westg. (2)	1150

PLUS 40 additional units ½ to 40 KW

250 VOLT DC GENERATORS

KW	Make	Speed
2000	G. E.	NEW
1150	G. E.	NEW
750	G. E. (2)	NEW
500	G. E.	500
400	G. E.	NEW
250	Cr. Wh.	1200
200	El. Mchy.	900
150	G. E.	1200
125	G. E. (2)	1200
125	E. D.	1750
100	Delco (4)	1150
75	Westg.	900
75	Cr. Wh.	1150
60	N. W.	1150
40	Rel.	1750
40	G. E. 3-Unit	1150
25	G. E.	1200
17	A-C	1750
15	Star	1750
10	G. E.	1150

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1	150	G.E.	I-M	1200	S. B.
4	125	G.E.	I-M	720	S. B.
1	100	G.E.	I-M	1800	S. B.
1	100	West.	CW	1200	S. B.
1	100	West.	CW	900	S. B.
1	100	G.E.	I-M	720	S. B.

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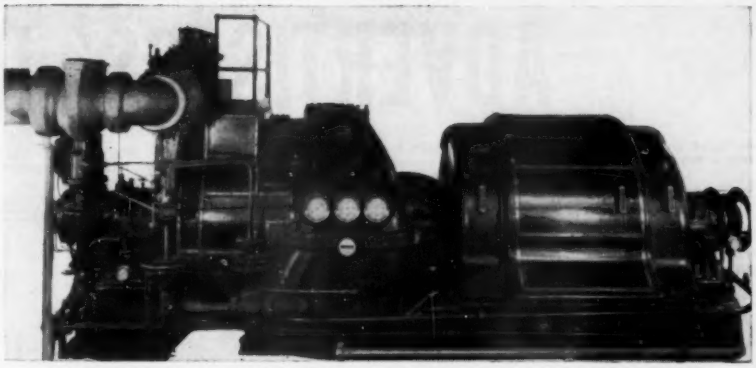
1875 KVA G.E. condensing, type F, 10 stage, 150 lbs., 3 phase 60 cycle 480 volts.

1250 KVA G.E. noncondensing, form B, 1 stage, 125-150 lbs. initial, 5-15 lbs. exhaust, 3 phase 60 cycle 2300 volts.

1250 KVA G.E. condensing, form E, 3 stage, 150 lbs., 3 phase 60 cycle 2300 volts.



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Adams Co., Inc., R. P. ..... *
AEG Allgemeine Elektricitats Gesellschaft Berlin-Grunewal (Western Germany) ..... *
Aerotec Corp. 185
Air Preheater Corp. 69
Allen-Sherman-Hoff Co. ..... Second Cover
Allis-Chalmers Mfg. Co. 18-19, 28, 46-47, 67, 169
Allpax Company Inc. 222
American Blower Corp. 42-43
American Brake Shoe Co. (Brake Shoe & Casting Div.) 284
American Chimney Co. 300
American District Steam Co., Inc. 44-45
American Engineering Co. 270
American Gilsonite Co. ..... *
American Locomotive Co. (Alco Products Div.) 245
American Pulverizer Co. 276
Ames Iron Works, Inc. ..... *
Anchor Packing Co. 215
Anderson Co., V. D. ..... *
Arkansas Fuel Oil Co. 219
Armstrong Cork Co. 207
Armstrong Machine Works 145

Babbitt Steam Specialty Co. 258
Babcock & Wilcox Co. 6-7
Badger Mfg. Co. 297
Bailey Meter Co. 10-11
Baldwin-Hill Co. ..... *
Baltimore & Ohio Railroad 161
Barrows Porcelain Enamel Co. 296
Belco Industrial Equip. Div. Inc. ..... *
Bell & Gossett Co. 239
Belmont Packing & Rubber Co. 230
Bendix Aviation Corp. (Friez Instrument Div.) ..... *
Bethlehem Steel Co. 289
Betz Co., W. H. & L. D. 143
Biddle Co., James G. ..... *
Bigelow Company ..... *
Bituminous Coal Institute 213
Black, Sivalls & Bryson Inc. ..... *
Blackmer Pump Co. 296
Blaw-Knox Co. 261
Boiler Tube Co. of America 242
Bonney Forge & Tool Works 249
Botfield Refractories Co. 258
Bros Boiler & Mfg. Co., Wm. ..... *
Brown Boveri Corp. ..... *
Buell Engineering Co. 228
Buffalo Forge Co. 35
Buffalo Pumps, Inc. 265
Builders-Providence, Inc. 178
Bussmann Mfg. Co. 72-73
Byers Co., A. M. 74

Carey Mfg. Co., Philip ..... *
Cash Co., A. W. 233
Catawissa Valve & Fittings Co. ..... *
Chapman Valve Mfg. Co. 179
Chase Brass & Copper Co. 263
Chesapeake & Ohio Railway 260
Chesterton Co., A. W. 232
Chicago Pneumatic Tool Co. 229
Childers Mfg. Co. ..... *
Cities Service Oil Co. 219
Clarage Fan Co. 271
Cleaver-Brooks Co. (Boiler Div.) 231
Cleveland Vibrator Co. ..... *
Cochrane Corp. 4
Coffin Jr., J. S. 214
Combustion Control Corp. ..... *
Combustion Engineering, Inc. 20-21
Cooper-Bessemer Corp. ..... *
Copes-Vulcan Div. Continental Foundry & Mach Co. 12-13, 14-15
Coppus Engineering Corp. 183
Corning Glass Works 250
Crane Company 64, 163
Crane Packing Co. 176
Crawford Fitting Co. ..... *
Cyclotherm Corporation ..... *

Darling Valve & Mfg. Co. 48
Dart Union Co. 224
Dean Hill Pump Co. ..... *
Dearborn Chemical Co. ..... *
De Laval Separator Co. 195
De Laval Steam Turbine Co. 2, 187
Deming Company 244
Detroit Stoker Co. 193
Diamond Power Specialty Corp. 8-9
Dodge Mfg. Corp. ..... *
Dowell, Inc. 175
Downingtown Iron Works Inc. 222
Dravo Corporation 256

Eagle-Picher Co. 293
Edward Valves, Inc. 223
Electric Machinery Mfg. Co. 287
Elgin-Refinite, Div. of Elgin Softener Corp. ..... *
Elliott Company 40-41
Ellison Draft Gage Co. 294
Engineer Company 210
Enos Coal Mining Co. ..... *
Erico Products, Inc. 253
Erie City Iron Works ..... *
Ernst Water Column & Gage Co. 300
Everlasting Valve Co. 236

FenePainteR Corp. 294
Fisher Governor Co. 58-59
Flexitallic Gasket Co. ..... *
Flexonics Corp. ..... *
Fluor Corp., Ltd. 255
Foster Engineering Co. 242
Foster Wheeler Corp. 56-57
Foxboro Company ..... *
Frick Company 252
Fuller Company 291

Garlock Packing Co. 184
General Cable Corp. 70
General Electric Co. (Apparatus Dept.) 28-29, 33-34, 65
General Refractories Co. ..... *
Globe Steel Tubes Co. 272
Golden Anderson Valve Spec. Co. 220
Goodrich Co., B. F. ..... *
Goulds Pumps, Inc. 182
Graver Water Conditioning Co. 191
Green Fire Brick Co., A. P. 257
Green Fuel Economizer Co. ..... *
Greene, Tweed & Co. ..... *
Grinnell Company ..... 165, Third Cover
Griscom-Russell Co. ..... *
Gustin-Bacon Mfg. Co. ..... *

Hagan Corporation 152-153
Hall Laboratories 181
Hammel-Dahl Company 211
Haynes Products Co. 300
Hays Corporation 32
Hendrick Mfg. Co. ..... *
Henzey Company 234
Hewitt-Robins, Inc. 60-61
Hill Pump Valve Co. ..... *
Hilliard Corporation ..... *
Hills-McCanna Co. ..... *
Hoffman Specialty Mfg. Corp. ..... *

Illinois Water Treatment Co. 170
Industrial Instruments, Inc. ..... *
Infilco Inc. ..... *
Ingersoll-Rand Co. 203
International Nickel Co. 66
Iron Fireman Mfg. Co. 24-25

Jeffrey Mfg. Co. ..... *
Jenkins Bros. 149
Jerguson Gage & Valve Co. ..... *
Johns-Manville 159
Johnson March Corp. 275
Johnson Service Co. ..... *
Johnston & Jennings Co. 247
Johnston Pump Co. 298
Joy Mfg. Co. 197

Keasbey & Mattison Co. 278
Kennedy-VanSaun Mfg. & Engrg. Corp. ..... *
Kewanee-Ross Corp. 251, 318
Key Company ..... *
Klipfel Valves Inc. 294
Klöckner-Humboldt-Deutz., A. G. Köln, R. H., Germany 296
Koons & Co., Charles A. 267
Koppers Co., Inc. (Coupling Dept.) 49
Kuljian Corp. 248

Laclede Stoker Co. ..... *
Ladish Company ..... *
Leeds & Northrup Co. ..... *
Leslie Company ..... *
Link-Belt Co. 1
Lockett & Co., Ltd., A. M. ..... *
Lonergan Co., J. E. 230
Lubriplate Div. Fiske Bros. Refining Co. 210
Lummus Company (Fabricated Piping Div.) ..... *
Lunkenheimer Company ..... *

Mahon Co., R. C. ..... *
Manning, Maxwell & Moore, Inc. 22-23
Marley Company 243
Marsh Instrument Co. ..... *

Mason-Neilan Regulator Co. 273
McAlear Mfg. Co. *
McGraw-Hill Book Co. *
McKiernan-Terry Corp. *
Mercoid Corporation *
Metco Systems *
Midwest Piping Co., Inc. 235
Milton Roy Co. *
Industrial Div. Minneapolis-Honeywell Reg. Co. 36-37
Mundet Cork Co. *
Murray Mfg. Co., D. J. 246
Murray Iron Works Co. 212

National Airoil Burner Co., Inc. 188
National Aluminate Corp. 151, 186
National Conveyors Co., Inc. 216
National Tube Co. 280
National Valve & Mfg. Co. 209
Niagara Blower Co. 200
Nicholson & Co., W. H. 234
Nordberg Mfg. Co. 157
North American Mogul Products Co. 283
Norton Company 205

Oakite Products, Inc. 238
Ohio Brass Co. 110
Ohio Valley Electric Corp. 254
Orr & Sembower Inc. 62-63

Palmer Thermometers Inc. *
Panalarm Products, Inc. 194
Panellit, Inc. *
Peabody Engineering Corp. 192
Peerless Electric Co. (Fan & Blower Div.) 238
Peerless Pump Div. (Food Machy. & Chemical Corp.) *
Penberthy Injector Co. 299
Pennsylvania Flexible Metallic Tubing Co., Inc. 277
Pennsylvania Pump & Compressor Co. *
Permutit Company Back Cover
Perolin Co., Inc. 288
Petro *
Philadelphia Gear Works 217
Phoenix Mfg. Co. (Flange Div.) 298
Pittsburgh Piping & Equipment Co. 268
Powell Co., Wm. 167
Power 258-259
Powers Regulator Co. 135
Pritchard & Co., J. F. 264
Pure Oil Co. *

Radio Corp. of America 295
Raybestos-Manhattan Inc. Manhattan Rubber Div. *
Raybestos-Manhattan Inc. (Packing Div.) 286
Ray-O-Vac Company *
Refractory & Insulation Corp. 218
Republic Flow Meters Co. 16-17
Republic Mfg. Co. *
Republic Steel Corp. *
Research Corporation *
Revere Copper & Brass, Inc. *
Ric-Wil Company *
Ridge Tool Co. 180
Riley Stoker Corp. 108-109
Rohm & Haas Co. (Resinous Prod. Div.) 237
Roto Div. of Elliott Co. 204

Sarco Company 147
Schaub Engrg. Co., Fred H. 285
Shell Oil Co. 241
Simplex Valve & Meter Co. 252
Sinclair Refining Co. 177
Socony-Vacuum Oil Co., Inc. *
Spence Engineering Co. 68
Springfield Boiler Co. *
Squires Co., C. E. *
Standard Oil Co. of Indiana 227
Steamaster Automatic Boiler Co. 298
Steel & Tubes Div. *
Stephens-Adamson Mfg. Co. 39
Sterling Engrg. & Mfg. Corp. 256
Stickle Steam Specialties Co. *
Stock Equipment Co. 281
Stone & Webster Engrg. Co. 225
Strong, Carlisle & Hammond 196
Struthers Wells Corp. *
Sun Oil Company 141
Superior Combustion Industries 50, 173

Taylor Instrument Co's. 290
Taylor & Co., W. A. 216
Tennessee Corporation *
Terry Steam Turbine Co. 226
Texas Company *
Thermix Corp. 185
Thompson Products, Inc. *
Titusville Iron Works Co. *
Tube Turns, Inc. 189-190

U. S. Electrical Motors, Inc. *
United States Gauge (Div. of Amer. Mach. & Metals Inc.) 208
United States Rubber Co. (Mechanical Goods Div.) 221
U. S. Steel Corp. 280

Van Der Horst Corporation 199
Velan Engineering Co. *
Viking Pump Co. *
Vogt Machine Co., Henry 266

Wallace & Tiernan Co., Inc. 202
Walsh Refractories Corp. *
Walworth Company 279
Warren Refining Chemical Co. 250
Warren Steam Pump Co., Inc. 206
Watson-Stillman (Fittings Div. H. K. Porter Co.) 201
Western Chemical Co. *
Western Precipitation Corp. 282
Westinghouse Electric Corp. 51-52-53-54
Westinghouse Electric Corp. (Sturtevant Div.) 155
Wheeler Mfg. Co., C. H. 262
Where to Buy 300
Wickes Boiler Co. 26-27
Wiedeke Co., Gustav 256
Wiegand Co., Edwin L. (Ind. Div.) 246
Wilson, Inc., Thomas C. *
Wing Mfg. Co., L. J. 240
Worthington Corp. 55
Wright-Austin Co. 198

Yarnall-Waring Co. 30-31, 137

Zallea Bros. *
Zimmerman Packing Co. *

Professional Services 300

SEARCHLIGHT SECTION

(Classified Advertising)

H. E. Hilty, Mgr.

EMPLOYMENT
Positions Vacant 303, 304
Selling Opportunities Offered 303
Positions Wanted 304

SPECIAL SERVICES 304

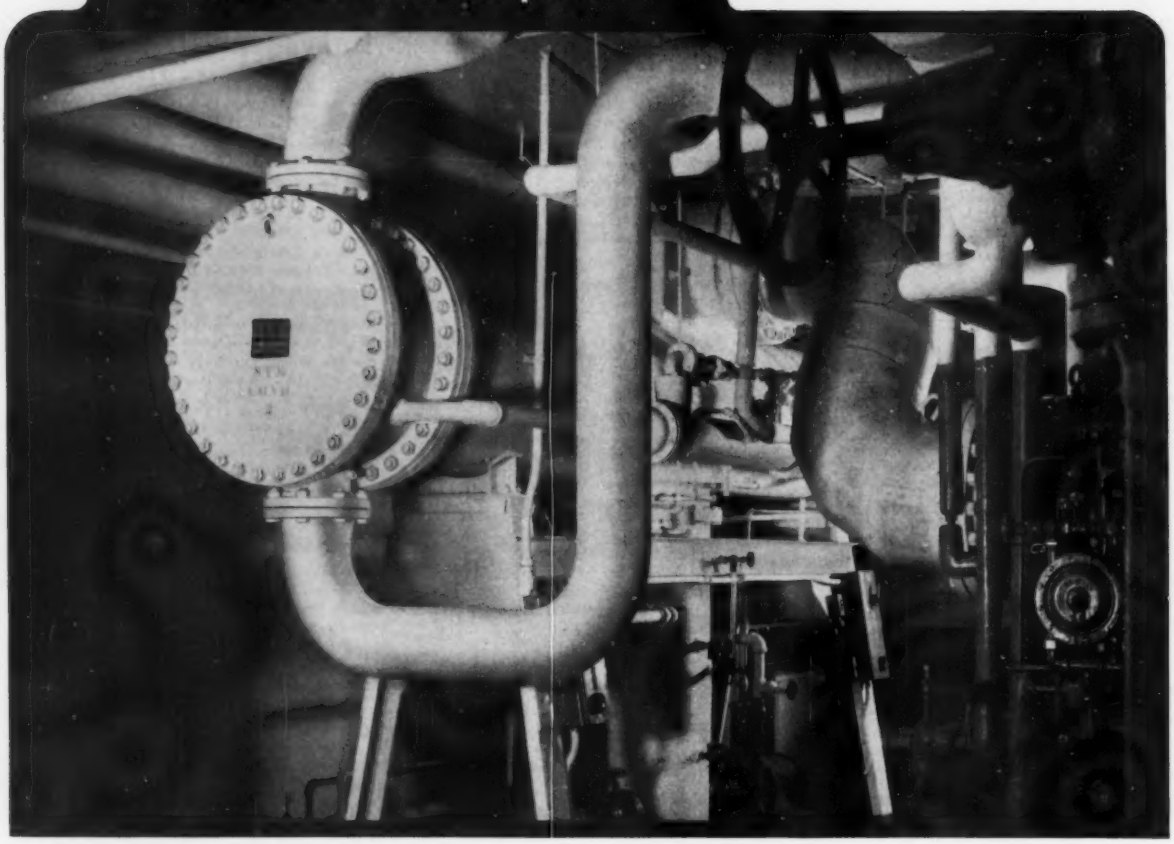
EDUCATIONAL 304

EQUIPMENT
(Used or Surplus New)
For Sale 304-315

WANTED
Equipment 304

ADVERTISERS INDEX
Aljon Electric Diesel Co. 306, 315
Allied Electric Co. 304
American Air Compressor Corp. 309
American Locomotive Co. 303
Behr & Sons Inc., Joseph 305
Belyea Co., Inc. 305
Benson-Wilimzig Inc. 311
Boiler & Equipment Co. 313
Boston Metals Co., Inc. 309, 310
Brown-Strauss Corporation 306
Buckeye Trading Co. 315
Burford, Hall & Smith 312
Chicago Electric Co. 310
DeRose, G. M. 311
Diamond Electric Co. 304
Ebasco Services, Inc. 312
Electric Equipment Co. 312
Electric Service Co. 310
Electric Products Sales Corp. 315
Erie Electric Co., Inc. 304
Goeringer, Harry F. 310
Gordon Steel Products Inc. 314
H & P Machinery 315
Hackney, R. A. 315
Hall & Co., Stephen 312
Hoffman & Co., Inc., Arnold 315
Hemphill & Co., J. L. 308
International Power Machinery Co. 315
Johnson & Assoc., H. Blaine 312
Knoxville Utilities Board 312
Land, L. J. 314
Lestan Corp. 312
MacCabe Co., T. R. 314
Miami Valley Coated Paper Co. 307
Michigan Chemical Corp. 314
Midwest Utilities Power Equipment Co. 306
Mississippi Valley Eqpt. Co. 313
National Biscuit Co. 304
National Electric-Service Co. 307
Newman & Co., Inc. 313
O'Brien Machinery Co. 313
Pelnik Wrecking Co., Inc. 312
Power Equipment Co. 310, 314
Rearick, Charles B. 313
Schoonmaker Co., Inc., A. G. 306, 307, 310, 313
Sherb, Werner J. 315
Smith Co., H. Y. 315
Stanhope Inc., R. C. 313
Strickler Engineering Corp. 311
Tampa Armature Works Inc. 308
Wagner Co., Arthur 309
Walker & Collins 304
Weaver, Charles 311, 312, 315
Welding Engineers Inc. 304

Here's a K-R Report . . .



on the Dun & Bradstreet Building's Surface Condenser Installation

Condensing exhaust steam from a 585 hp Worthington turbine which drives a centrifugal refrigeration compressor, this Ross Surface Condenser is an important component of the air conditioning system in the new Dun & Bradstreet Building, New York City. There are two of these Ross units in service.

Dun & Bradstreet, Inc. is another important name in the long list of renowned companies which the Kewanee-Ross organization is privileged to serve. Everywhere, in industries and public utility power plants throughout the world, Ross Surface Condensers rate high . . . *and have for years!*

Long a leader in the surface condenser field and famous for its many noteworthy design improvements, Kewanee-Ross is today in the best position of its history to meet your requirements. With recently expanded manufacturing facilities . . . with two large plants to serve you now . . . Kewanee-Ross is ready to engineer, fabricate and deliver *exactly* what you need in surface condensers.

You will be impressed with the facts and figures that will come out of a brief consultation with a Kewanee-Ross engineer. Arrange a date, *at your convenience,* soon.

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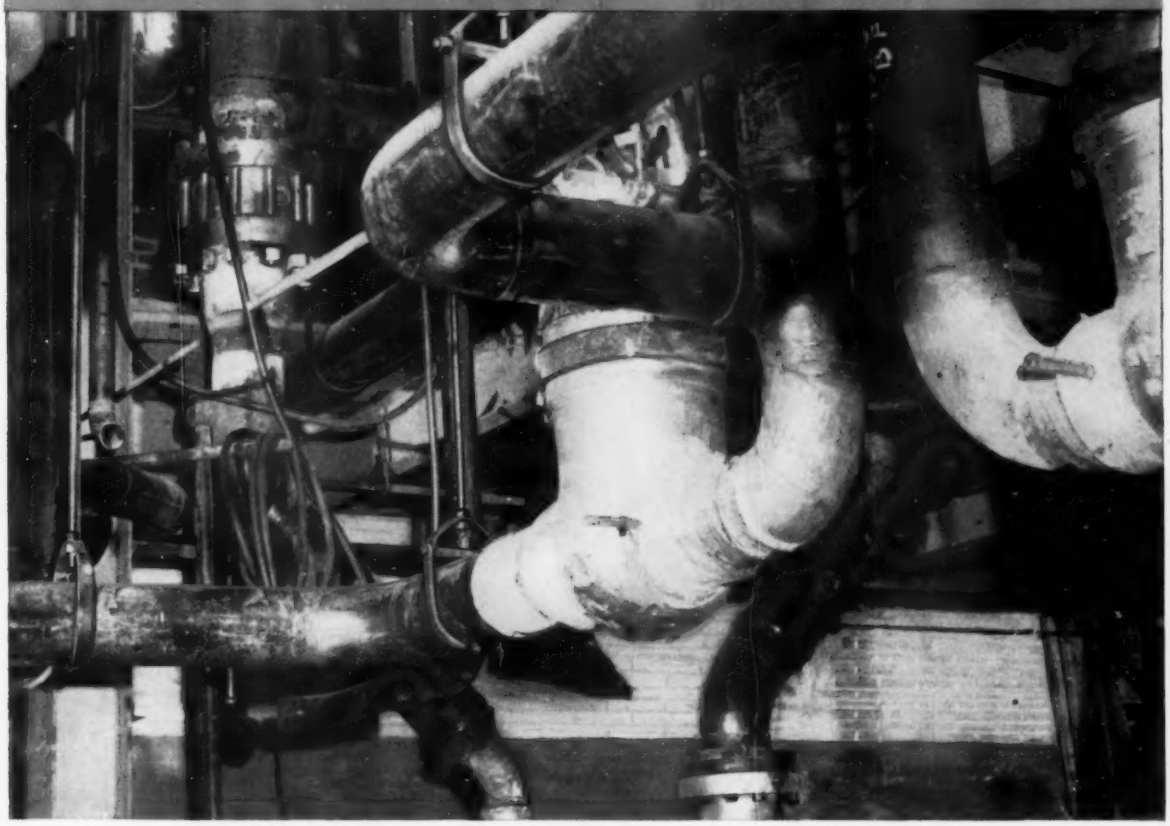
STRONGER THAN PIPE



Boiler feed discharge piping shown under construction above will operate at 2700 psi and 430° F.

Grinnell Welding Fittings

exceed bursting strength of seamless pipe

Grinnell Welding Fittings are designed and processed to have a bursting strength greater than the calculated bursting strength of the seamless pipe to which they are to be welded.

Welding elbows and bends are made from seamless steel pipe by a forging process which produces uniform wall thickness at all points; there is no thinning of outer wall.

Welding tees and crosses are made from seamless pipe by a drawing process which provides extra metal and protection at the crotch, where highest stress occurs.

All Grinnell Welding Fittings are process stress-relieved, thus improving grain structure and increasing the strength of the metal.

With all Grinnell Welding Fittings, you get true circularity; smooth, clean inside surface; full, effective radius; easy, sweeping turns; accurate bevels; and true included angles. Available in a wide range of types and sizes, metals and alloys. Send for descriptive catalog.

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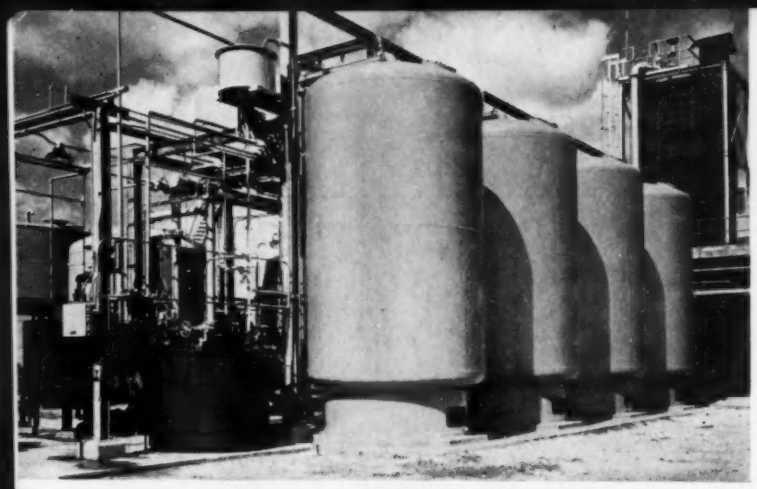
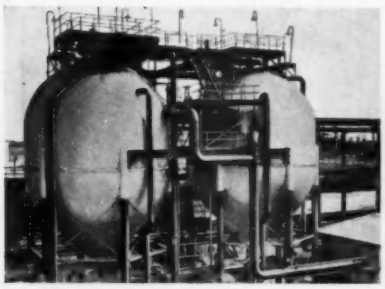
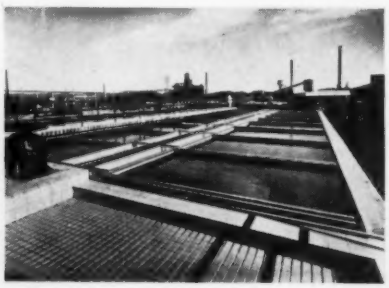


Automatic Demineralization and Silica Removal. *Permutit Ion Exchangers deliver the equivalent of distilled water at far less cost. Eliminate makeup shortages . . . operate independently of changes in turbine load. Fully automatic operation insures precision performance.*

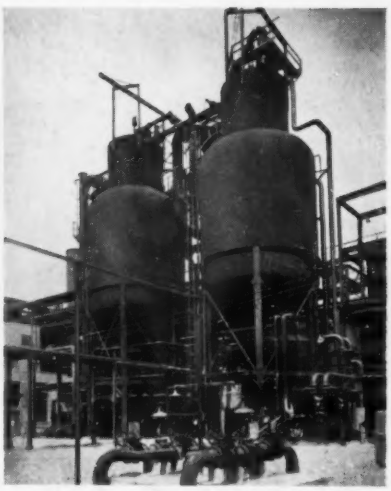
WHICH Permutit Process will solve YOUR water problem?



Sludge-Blanket Hot Lime-Soda Softener *reduces hardness . . . silica . . . alkalinity and turbidity. Fully utilizes Permutit sludge-blanket principle to improve performance.*



Precipitator *clarifies and softens cold water. Uses less space, time and chemicals than previous designs. Removes hardness, turbidity, color, iron, manganese. Reduces silica, alkalinity.*



Deaerating Heater *removes troublesome oxygen and CO_2. Prevents corrosion and pitting of feed lines, stage heaters, economizers and boilers at high temperatures. Steam is used twice . . . deaerates water completely.*

Your Permutit sales engineer can help you decide . . .

Making the wisest choice requires time-consuming consideration of all types of equipment, ion exchange materials, controls, accessories. That's where Permutit can help you.

Permutit Sales Engineers work with a complete range of equipment—all types, all sizes. They do not have to compromise by trying to fit one specific process to your plant.

They can recommend with impartiality the one proper combination of equipment and materials that best solves your problem. For only Permutit manufactures both ion exchange resins and all types of water conditioning equipment.

This results in better performance at lower operating cost . . . undivided responsibility for the complete plant . . . plus savings of time and money in planning and specification.

For aid in solving your water problem, write to The Permutit Company, Dept. P-4, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER FORTY YEARS

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